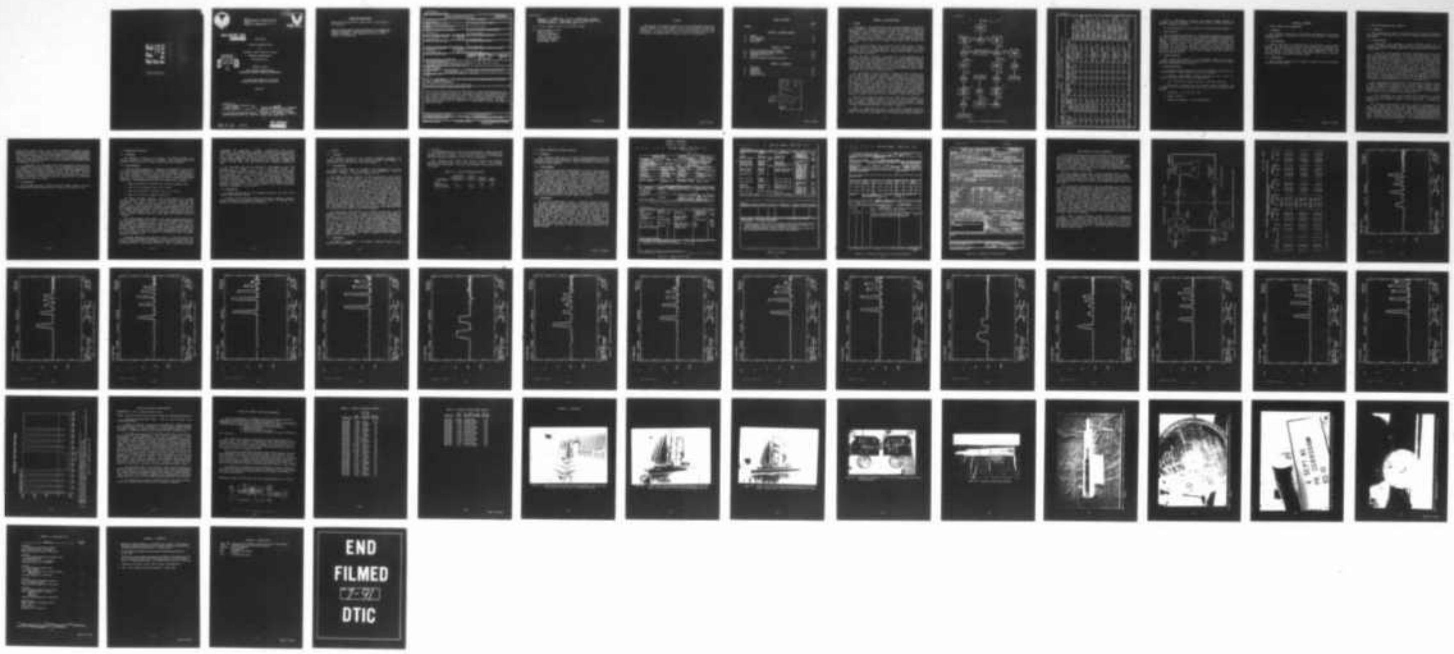
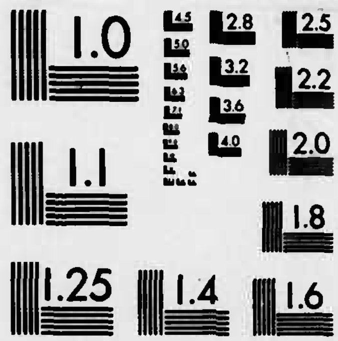
AD-B155 752L FOLLOW-ON PRODUCTION TEST OF CARTRIDGE 105-MM HEAT-T-MP 1/1
M456A2 (CORROSION (U) ARMY COMBAT SYSTEMS TEST
ACTIVITY ABERDEEN PROVING GROUND MD C M SMITH JUN 91

UNCLASSIFIED USACSTA-7146 XA-AMCCOM USGO





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TECOM PROJECT NO. 1-MU-001-456-075
RDTE NO. ______________________
REPORT NO. USACSTA-7146

US ARMY MATERIEL COMMAND

FINAL REPORT

FOLLOW-ON PRODUCTION TEST OF CARTRIDGE, 105-MM, HEAT-T-MP, M456A2 (CORROSION INVESTIGATION),

TPR DSM-AB-3496-1A

CHILEAN M. SMITH

HEAVY WEAPONS SYSTEMS DIVISION
ARMAMENT AND ADVANCED TECHNOLOGY DIRECTORATE

U. S. ARMY COMBAT SYSTEMS TEST ACTIVITY
ABERDEEN PROVING GROUND, MD 21005-5059

JUNE 1991

Prepared for:
U.S. ARMY ARMAMENT, MUNITIONS, AND
CHEMICAL COMMAND
PICATINNY ARSENAL, NJ 07806-5000

U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MD 21005-5055

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This Follow-On Production Test was conducted between 15 January 1990 through March 1991 for the corrosion study investigation. Laboratory and primer tests addressed the areas of rack vibration, humidity cycling, salt-fog, moisture content of propellant and strand benite samples, and primer functioning tests. The environmental conditions produced the worst results from the vibration, humidity, and salt-fog sequential test. The final analysis and evaluation will be conducted by U.S. Army Armament, Research, Development and Engineering Center.

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M456A2 cartridge
Corrosion investigation
Electric primer, M83
Propellant, M30, analysis
Strand benite analysis
Environmental tests

Unclassified

FOREWORD

Appreciation is extended to Headquarters, U.S. Army Armament, Materiel and Chemical Command at Picatinny Arsenal for assistance in obtaining additional specifications, and to Mr. Ronald Williams for assisting in the final inspections. The support groups of the U.S. Army Combat Systems Test Activity are commended for completing their respective tests in a timely manner.

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SECTION 1. EXECUTIVE DIGEST

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SECTION 3. APPENDICES

SECTION 1. EXECUTIVE DIGEST

1.1 SUMMARY

Environmental tests and post-test inspections were conducted on ten M456A2 test cartridges in accordance with existing Military Standards (MIL-STD) and International Test Operating Procedures (ITOP). The ten factory-fresh test cartridges (section 2.1) were subjected to vibration (section 2.2), temperature and humidity cycling (section 2.3), salt-fog (section 2.4), and physical teardown (section 2.5) according to Figure 1-1, Environmental Test Flow Chart. Physical teardown of each test cartridge included collecting propellant and benite samples from the top, middle, and bottom areas of each test cartridge.

All ten test cartridges were subjected to the initial 4-hour vibration test. Post-vibration visual inspections revealed only abrasions and no corrosion. These ten test cartridges were split into two groups: one group consisting of test cartridges 1 through 4 and the second group consisting of test cartridges 5 through 10.

Test cartridges 1 through 4 were subjected to a 14-day temperature and humidity cycle and post-test visual inspection. No visual damage was observed during the inspection. Test cartridges 3 and 4 were held for physical teardown. Cartridges 1 and 2 were subjected to a 4-hour vibration test and post-vibration visual inspection which revealed additional and more-severe abrasions. These cartridges were further subjected to 14 days of temperature and humidity cycling and post-test visual inspection which revealed no further damage. These cartridges were then held for physical teardown.

The second group of test cartridges (5 through 10) were subjected to a 48-hour salt-fog test and post-test visual inspections after 24- and 48-hour time periods. Light exterior oxidation and salt deposits were observed after the 24 hours and more severe exterior oxidation and heavier deposits observed after the 48-hour period. Cartridges 9 and 10 were held for teardown. Test cartridges 5 through 8 were split again into two groups: one group consisting of cartridges 7 and 8. Cartridges 5 and 6 were subjected to 8 hours vibration and a post visual inspection that revealed more severe abrasions. Cartridges 5 and 6 were held for physical tear down. Test cartridges 7 and 8 were subjected to another 4-hour vibration test and 14-day temperature and humidity cycling with visual inspection after each test. Inspection revealed additional, severe abrasions. Physical tear downs were then performed on these test cartridges.

Physical tear downs and final post-test inspections are summarized in Table 1-1. Test cartridges 1 through 4 had the least corrosion deposits, while test cartridges 5 through 10 had the heaviest corrosion deposits. Minimum moisture deviation, when compared to specifications, was observed in cartridges 1 through 4 and maximum deviation in cartridges 5 through 10.

Table 1-1 also shows that four of five primers functioned after the teardown in the primer functioning tests conducted in the APG primer functioning device. The primer from cartridge 10 did not function after several attempts.

1.1 (Cont'd)

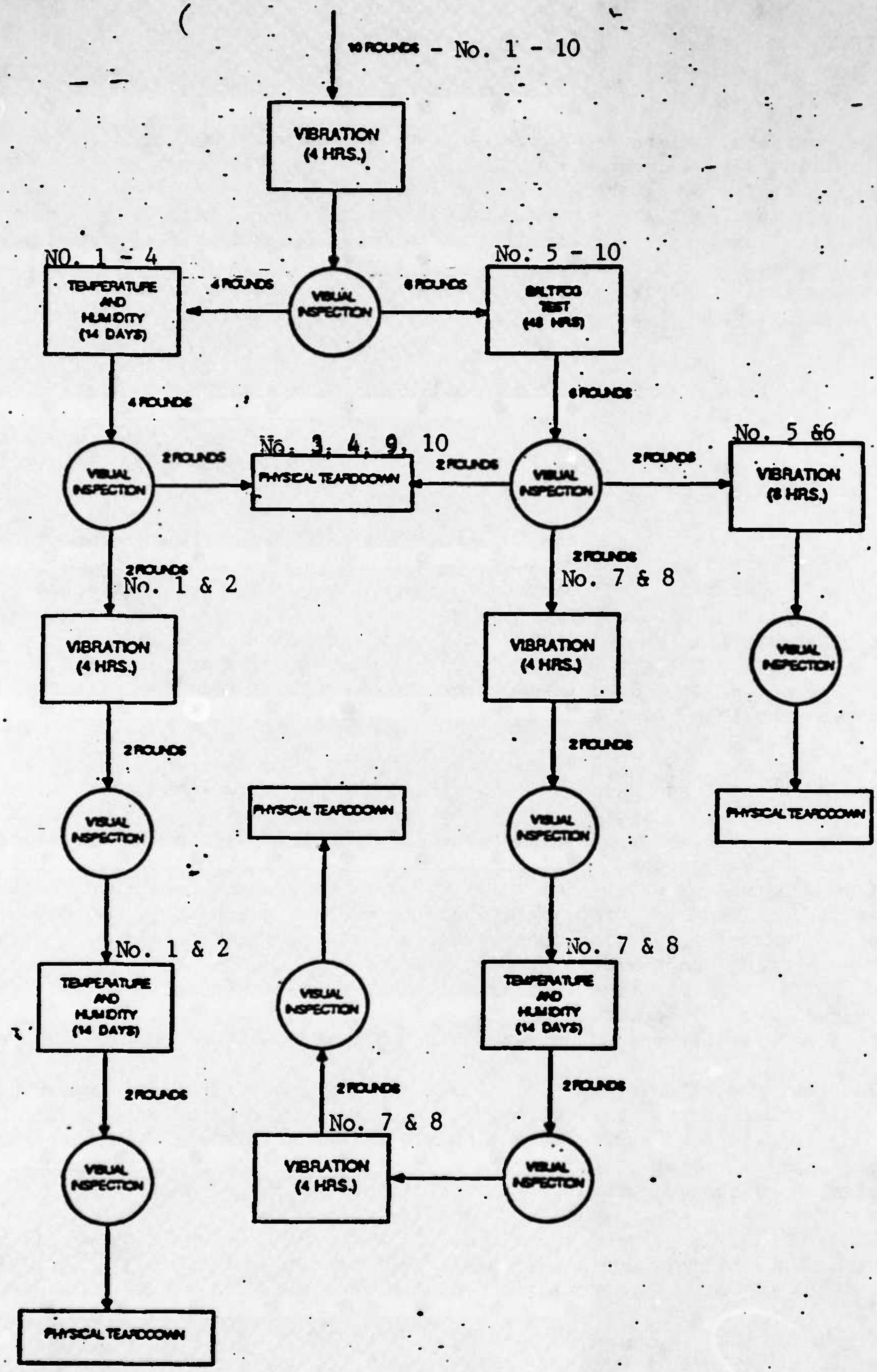


Figure 1-1. Environmental Test Flow Chart.

TABLE 1-1. SUMMARY OF INSPECTION RESULTS

TEST ITEM: M456A2, HEAT-T-MP CARTRIDGES. TECOM PROJECT NUMBER: 1-MU-001-456-075
CARTRIDGE LOT: MA-83L140-026

TEAR DOWN DATE, 1990	CTG ID	TYPE ENVIR COND.	BULLET PULL FORCE, lbs	ELECTRICAL CONTINUITY, OHMS	PROPELLANT SAMPLES, % MOISTURE CONTENT 1 (TOP)	2 (MID)	3 (BOT)	PRIMER BENITE SAMPLES, % MOISTURE 1 (TOP)	2 (MID)	3 (BOT)	REMARKS OVERALL
1 OCT	1	TV,TH, TV,TH	6960	1.2	0.28	0.28	0.28	HELD FOR FIRING ATTEMPT			FIRED 10 OCT @ 1033, DURATION= 3.080 MS
1 OCT	2	TV,TH, TV,TH	5770	1.0	.31	.31	.31	0.89	1.00	0.80	HIGH % MOISTURE IN THE BENITE SAMPLES
1 OCT	7	TV,SF, TV,TH, TV	4990	1.5 - 2.0	.47	.57	.61	1.30	1.55	1.62	HIGHEST % MOISTURE IN THE BENITE SAMPLES
1 OCT	8	TV,SF, TV,TH, TV	5530	1.5 - 2.5	.41	.39	.42	HELD FOR FIRING ATTEMPT			FIRED 10 OCT @ 1116, DURATION= 6.475 MS
4 SEP	3	TV,TH	6240	1.6	.32	.29	.27	0.76	0.83	0.86	LOWEST % MOISTURE IN OVERALL SAMPLES
4 SEP	4	TV,TH	6200	1.3	.35	.35	.32	HELD FOR FIRING ATTEMPT			FIRED 10 OCT @ 1113, DURATION= 9.400 MS
4 SEP	9	TV,SF	6200	1.2	.37	.31	.27	0.94	0.94	0.84	HIGH % MOISTURE IN BENITE SAMPLES
4 SEP	10	TV,SF	5800	1.2	.55	.48	.52	HELD FOR FIRING ATTEMPT			FIRING ATTEMPT ON 18 OCT. PRIMER DUD (1120)
12 SEP	5	TV,SF TV	9770	3.4	.27	.32	.68	0.95	0.99	0.97	HIGH % MOISTURE IN BENITE SAMPLES
12 SEP	6	TV,SF	9760	2.0	.20	.15	.19	HELD FOR FIRING ATTEMPT			FIRED 10 OCT @ 1104, DURATION= 10.115 MS

NOTE: CARTRIDGE NUMBERS 5 AND 6 HAD MOST CORROSION BUILD UP AROUND THE PRIMER.

The U.S. Army Armament, Munitions and Chemical Command (AMCCOM) of Picatinny Arsenal is conducting the remaining two parts of this investigation and will write the final report.

All raw data were sent to the sponsor for final analysis and assessment.

1.2 TEST OBJECTIVES

The environmental test was part of a three-part investigation to determine the cause of primer corrosion in the 105-mm, HEAT-MP-T, M456A1 tank ammunition. Figure 1-1, Environmental Test Flow Chart, has been developed as a guide for the sequence of testing for vibration, temperature and humidity, salt-fog, and teardown. Teardown consists of conducting disassembly of the M456A1 test cartridges for bullet-pull, electrical continuity, visual and documented observation of any corrosion deposits or buildup, and moisture content of propellant and benite strands. Ten factory-fresh test cartridges were selected for this test to determine if any of the problems were the results of manufacturing deficiencies.

1.3 TESTING AUTHORITY

This project was assigned to U.S. Army Combat Systems Test Activity (USACSTA) under TECOM Project No. 1-MU-001-456-075 to be tested in accordance with Test Program Request DSM-AB-3496-1A.

1.4 SYSTEM DESCRIPTION

The M456A2 cartridges subjected to the tests contained in this report were tested unpackaged. Each cartridge consists of the following:

a. Projectile high-explosive antitank multipurpose with tracer. The projectile contains 1.9 kg (4.28 lb) of Composition B.

b. Fuze: Piezoelectric element attached to a base detonating fuze.

c. Tracer: M13 consisting of 1.8 grams of igniter composition and 5.7 grams of tracer composition contained in a steel cup in the projectile tail assembly.

d. Propellant: 5.7 kg (12.5 lb) of M30.

e. Primer: Electric.

f. Additional information: lot No. MA83L140-026.

SECTION 2. SUBTESTS

2.1 INITIAL INSPECTION AND MEASUREMENTS

2.1.1 Objective

The objective of this test was to inspect and measure the ten initial production samples and compare the results with the applicable standards and specifications.

2.1.2 Test Procedure

Initial inspection and measurement data were provided by the sponsor (AMCCOM) upon the arrival of the ten test cartridges at the USACSTA test facility. The data from the government inspector at the Milan Army Ammo Plant were documented on ammunition data cards and DA FORM 3022-R, 1 May 1976 (fig. A-1 through A-4). These documented data were compared with the standard specifications for a pass/fail decision or waiver.

2.1.3 Test Results

Each production M456A2 test cartridge was accepted for the environmental and physical teardown phase.

(Page 2.1-2 Blank)

2.2 INSTALLED-EQUIPMENT (RACK) VIBRATION

2.2.1 Objective

The objective was to subject the cartridges to the vibration environment which simulates normal operation, then check for primer corrosion as a result of the exposure.

2.2.2 Test Procedure

a. Temperature. Ten cartridges, 105-mm, HEAT-T-MP, M456A2 (No. 1 through 10) were not temperature-conditioned prior to or during testing. All testing was conducted at ambient temperature which ranged between 14 and 34 ^{o}C (57 and 93 ^{o}F).

b. Test Setup. The unpackaged cartridges were placed in the 8-tube hull rack for the M1 tank and subjected to the rack vibration simulation in each of their three orthogonal axes (vertical, transverse, and longitudinal). The bare cartridges were placed horizontally in an M1 hull rack that had been removed from the hull of a tank and mounted into an aluminum fixture in the same manner and orientation as it is mounted in the vehicle. The test cartridges were placed in the lowest tube location within the rack. The number of test cartridges for each load varied according to the flow chart in Figure 1-1. Testing was conducted on top of the vibration table for the vertical axis and on the slip-table for the transverse and longitudinal axes. For vibration in the vertical direction (fig. B-1), the longitudinal axis of the cartridges was perpendicular to the axis of applied force. For the longitudinal vibration, (fig. B-2), the longitudinal axis of the cartridges was parallel to the axis of applied force. For the transverse axis (fig. B-3), the longitudinal axis of the cartridges was again perpendicular to the axis of the applied force.

The shaker-amplifier systems used for all testing were the Unholtz-Dickie TA460W400 systems which utilize 18,144-kg (40,000-lb-force) exciters. Control of these systems was accomplished using Spectral Dynamics SD1201 Digital Vibration Controllers (illustrated in app A, A-4). Two calibrated control accelerometers were positioned on the front of the fixture at the attachment points, one on the left side and one on the right side.

c. Test Parameters. The bare cartridges were subjected to the rack vibration test in accordance with ITOP 1-2-601 (app C, ref 5). The vibration spectra used are defined in Table A-1 and illustrated in Figures A-5 through A-19.

The vibrations represented the environment of the M1 tank ammunition hull rack. These spectra were derived from measurements on the vehicle while operating at various speeds on paved roads. Excitation was applied sequentially through the three major axes of the test items. The cartridges were subjected to the schedules consisting of a flat, low-level, broad band, random excitation across the total frequency spectrum (5 to 500 Hz), with higher level, narrow bands of random excitation superimposed on the broad band environment. The narrow bands of random energy were formed by the track-laying patterns and are

vehicle-speed related. These were swept simultaneously across the total frequency bandwidth of the applicable narrow band at the specified sweeping bandwidth and sweep rate. This installed-equipment (rack) vibration environment was conducted in five phases (per orientation) for 45 minutes per phase for a total test time of 225 minutes per axis. This environment represented 8000 km (5000 mi) of tank transport per axis. These test schedules were developed using an exaggeration factor of 2.0.

d. Inspections. The cartridges were visually inspected prior to and at the completion of each axis of vibration. At the completion of all three axis of vibration, the cartridges were again visually inspected for damage prior to being subjected to the next environmental tests. The cartridges then went through additional rack vibration and environmental tests (fig. 1-1). All rack vibration testing was conducted using the same test procedure and equipment as previously mentioned. Following the required sequential tests, the cartridges were returned for physical teardown.

2.2.3 Test Results

The cartridges sustained no visible evidence of damage; however, the steel cartridge cases had minor abrasions which are typical for this type of test.

2.3 TEMPERATURE AND HUMIDITY

2.3.1 Objective

The objective of this test was to subject the M456A2 cartridge to the adverse conditions of temperature and humidity, then check the primer for corrosion or deterioration as a result of these accelerated exposures.

2.3.2 Test Procedure

A total of four cartridges, No. 1 through 4, were subjected to the first of two 14-day temperature-and-humidity environmental exposures. Testing was in accordance with MIL-STD-331A (ref 3), Test 105.1 (as modified by the sponsor's test plan), Procedure 2, single chamber cycling method. The modifications to Test 105.1 specified by the test sponsor were because the minimum and maximum temperature storage limits for the M456A1 are -54 and 63 °C (-65 and 145 °F), respectively. The modifications specified by the sponsor were as follows:

a. Change all reference to the bare fuze to read the complete round.

b. Where -54 °C is required, using -32 °C (-25 °F).

c. Where -62 °C (-80 °F) is required, using -40 °C (-40 °F).

d. Where 74 °C (165 °F) is required, using 63 °C.

The M456A2 cartridges subjected to this test previously went through installed equipment (rack) vibration. The bare cartridges were positioned horizontally, on teflon cutouts, in a manner similar to which they are positioned in the tank rack, and subjected to the 14-day temperature and humidity cycle. They were visually inspected for any anomalities as they were being removed from the containers. The cartridges were placed in the center of the chamber and were separated by about 9 cm (4 in.) from each other and 5 cm (2 in.) from the chamber floor. The unobstructed usable chamber space was 3 meters long by 2.4 meters wide by 2.1 meters high (10 ft long by 8 ft wide by 7 ft high).

The relative humidity was controlled (fig. A-20) during those portions of the cycle that were above 21 °C (70 °F). The relative humidity and temperature were programmed to gradually increase from 75 to 95 percent and 21 to 63 °C, respectively. The relative humidity was maintained at 95 ± 5 percent when the internal chamber temperature was 63 °C. When the internal chamber temperature decreased from 63 to 21 °C, the relative humidity also gradually decreased from 95 to 75 percent. At this point, the chamber humidification system was turned off and the humidity within the chamber was uncontrolled while the chamber temperature was below 21 °C.

The chamber temperature was maintained within ±1.7 °C (±3 °F) except during the increasing and decreasing temperature portions of the diurnal cycles. The chamber temperature-humidity was programmed and controlled using a calibrated microprocessor-based, multi-looped controller with time-versus-set-point

programming and proportional, integral, and derivative (PID) control capabilities. The temperature was monitored throughout the testing using four type-T thermocouples. The relative humidity was also monitored throughout the test using two calibrated sensors and electronic indicators. These analog signal inputs (temperature and relative humidity (voltage)) were recorded using a Doric 245 data logger. This information was also recorded on a MEMTEC 2500 digital recorder. These data were recorded every 15 minutes throughout the test.

The cartridges were visually inspected at the completion of the 14-day exposure. Two cartridges, No. 1 and 2, then went through the installed-equipment (rack) vibration and the remaining two cartridges, No. 3 and 4, were returned for physical teardown. After rack vibration testing, four cartridges, No. 1, 2, 7, and 8 were subjected to the second 14-day temperature-and-humidity exposure using the same procedure and equipment as previously mentioned. Following the second 14-day exposure, cartridges No. 1 and 2 were returned for physical teardown and cartridges No. 7 and 8 were returned for rack vibration. Prior to the second 14-day temperature-humidity exposure, cartridges No. 7 and 8 had been exposed to the salt-fog environment described in paragraph 2.4 of this report.

2.3.3 Test Results

No damage was observed to the cartridges following the first 14-day temperature-and-humidity exposure.

Following the second 14-day temperature-and-humidity exposure, a light to medium oxidation was observed on the exterior surfaces of cartridge case, projectile, and the fuze piezoelectric element cap.

2.4 SALT-FOG

2.4.1 Objective

The objective of this test was to subject the M456A2 cartridge to an aqueous salt-fog environment, then check the primer for corrosion or deterioration as a result of this accelerated exposure.

2.4.2 Test Procedure

A total of six cartridges, No. 5 through 10, were subjected to the salt-fog environment. Testing was in accordance with MIL-STD-810-D (ref 2), Method 509.2, Procedure 1 - Aggravated Screening (Cyclic).

The M456A2 cartridges subjected to this test previously went through installed equipment (rack) vibration. The cartridges were preconditioned at 35 ± 1.7 °C (95 ± 3 °F) for about 21 hours prior to the start of the salt-fog exposure. The cartridges were visually inspected for any anomalities as they were being removed from their containers. The cartridges were placed in the center of the chamber and were separated about 9 cm (4 in.) from each other and 5 cm (2 in.) from the chamber floor. The unobstructed usable chamber space is 3 meters long by 3 meters wide by 3.6 meters high (10 ft long by 10 ft wide by 12 ft high). For the first 8 hours of exposure, the cartridges, in specially designed nylon cutouts, were placed nose down with the primer facing the spray nozzles. For the next 8 hours of exposure, the cartridges were placed horizontally with the projectile ogive facing the spray nozzles. For the last 8 hours, the cartridges were placed base down on rubber mesh mats with the fuze piezoelectric element facing the spray nozzles. Following this 24-hour exposure, the cartridges were removed from the chamber and dried at a prevailing room temperature which ranged from 19 to 25 °C (66 to 77 °F). The cartridges were then exposed to a second 24-hour aqueous salt-fog environment and drying period using the same procedure as previously described.

The salt-fog was generated from a 5 ± 1 percent saline (NaCl) solution prepared by dissolving five parts, by weight, of salt in 95 parts, by weight, of distilled water. The salt used to prepare the solution was sodium chloride containing (on a dry basis) not more than 0.1 percent sodium iodine and not more than 0.5 percent total impurities. The chamber temperature was maintained at 35 ± 1.7 °C and was monitored and recorded on a standard, calibrated, circular-chart, recording controller utilizing a type-T thermocouple positioned in close proximity to the test items. Four glass receptacles with a 9.3-cm (3.7-in.) diameter opening were placed around the test items to collect the condensate. This condensate was used to determine the collection rate and the chemical contents of the fog. At the completion of the salt-fog exposures and drying periods, the cartridges were visually inspected for any evidence of damage or material deterioration.

2.4.3 Test Results

No damage or irregularities were observed during the pretest visual inspection of the cartridges.

2.4.3 (Cont'd)

At the completion of the first 24-hour drying period, moderate oxidation and salt deposits were found on the exterior surfaces of the cartridges. The oxidation and salt deposits on the exterior surfaces of the cartridges were more extensive following the second 24-hour drying period.

The distilled water used to make the salt solution had a measured resistance of 533,115 ohms at 25 ^{o}C (75 ^{o}F) and a pH of 6.7. The specific gravity and pH measurements of the salt-fog atmosphere are presented in Table 2.4-1 below.

TABLE 2.4-1. SALT-FOG ATMOSPHERE ANALYSIS

Test Phase	Collection Rate/Receptacle Hour, ml	Total Condensate, ml	Specific Gravity	pH Content
Pretest	-	-	5.4	6.9
First 24 hours	1.64	157.7	5.3	7.0
Second 48 hours	1.73	166.3	5.4	6.9

2.5 PHYSICAL TEARDOWN OF SELECTED CARTRIDGES

2.5.1 Objective

The objective of this test was to conduct physical teardown of ten M456A2 cartridges which have been subjected to various environmental conditions, then inspect for primer corrosion and collect samples of propellant and strand benite for moisture content analysis.

2.5.2 Test Procedure

Each M456A2 test cartridge was disassembled as it was received from its final previous environmental test. Photographs and physical observations were documented before, during, and after significant teardown progress. Propellant samples were collected from the top, middle, and bottom areas of the cartridge case for each M456A2 test cartridge. Included in the teardown documentation were bullet-pull force, electrical continuity, propellant-sample moisture, and primer benite-sample moisture. Also conducted was a functioning test of the primer, done in the APG primer function device. Five primers were disassembled for strand benite sampling and the remaining five primers were subjected to the functioning test. All propellant and strand benite samples were submitted to the USACSTA Chemistry Branch for moisture content analysis. Details of the procedures used are in Appendix A, pages A-24 through A-27. One black powder sample from base of the primer from cartridge 10 was collected at the sponsor's request but not analyzed due to the small sample size provided.

2.5.3 Test Results

The results are summarized in Table 1-1. Detailed moisture content data are in Tables A-2 and A-3. Table A-2 shows the moisture content of 30 samples of propellant (10 grams minimum weight) subjected to moisture content analysis. The analytical method (pages A-24 and A-25) was based on analysis of pure standard components separate from the sample. The moisture content of these 30 samples, with the exception of A90-0818, -0820, -08953, -1010, and -1011 was within the specification on the propellant description sheet (fig. A-3) of 0.5 percent maximum. Likewise, the moisture content of the 15 samples of benite was within that specified by section 3.4 of the Military Specification for benite strands (1.00 percent maximum) with the exception of samples A90-1015, -1016, and -1017. The absence of control rounds precludes USACSTA from making valuative statements as to the effects of salt-fog and temperature/humidity environments on the moisture content of propellant in the M456A2 cartridge.

APPENDIX A. TEST DATA

07. 24. 90 01:51 M *MILAN ARMY A MO PLT. P03

84-152

DEPARTMENT OF DEFENSE AMMUNITION DATA CARD		FORM APPROVED BUDGET BUREAU NO. 22-R0269	LOT NUMBER MA-83L140-026
ITEM NOMENCLATURE Cartridge, 105MM, HEAT-T-MP, M456A2 F/GUN M68	NSN 1315 01 023 7122-C508	PACKING OF LOT 1 Round/Fiber Container, PA82; 2 Fiber Containers/Wood Box, Dwg. 9321291/C; 15 Boxes/ 4-Way Pallet	
MFG., LOADING OR ASSEMBLING ACTIVITY MILAN ARMY AMMUNITION PLANT	NET QUANTITY 9,639		
CONTRACTOR MARTIN MARIETTA ALUMINUM SALES INC.	CONTRACT OR ORDER NO. PRON No. M11A0137	DRAWING OR REVISION 9312816, Rev. B	SPECIFICATION & REVISION See Note 1
DATE STARTED 11-22-83	DATE COMPLETED 3-20-84	DATE INSPECTED 3-20-84	LINE B / ZONE WT SHELL
CHARGE WEIGHT 199.8 ozs	EXPECTED MUZZLE VELOCITY 3,850 FPS	EXPECTED PRESSURE Unknown	SHELL WEIGHT Approx. 23.2 lbs
EXPLOSIVE WT PER PKG	INDEX OF POWDER	MPD IN INCHES	PPON IN INCHES
NUMBER OF TEST SAMPLES 25	SENT TO Jefferson P. G.	DATE AND MODE OF SHIPMENT 3-22-84 C/C	BTR No. 126-81

COMPONENTS (CONTINUE ON REVERSE, IF NECESSARY)

COMPONENTS	DRAWING NO.	MODEL	MANUFACTURER	DATE MFG LOT NO.	QUANTITY
Projectile Metal Parts Assy	9323824	M456A2	Chamberlain Mfg Corp	CG083E014-006	9,664
Locking Ring	10521640		" " "	Unk	

DISPOSITION ACCEPTED

TYPED NAME OF GOVERNMENT INSPECTOR For Jerry Laster

SIGNATURE William D Howell 4/13/84

DD FORM 1650 1 FEBRUARY 1968

COMPONENT (CONT. FROM FRONT)	DRAWING NO.	MODEL	MANUFACTURER	DATE MFG LOT NO.	QUANTITY
Liner	9217030/B		Indiana AAP	IND83E002-017	
Primer, Electric Loading Assy	8847476/J	M83	Lone Star AAP	LS-83E357-001 LS-83F357-002	9,264 400
"O" Ring Packing preformed	MS-28775-121		Percision Rubber Products Corp	12-83	
Propellant	MIL-P-46458	M30	Radford AAP	RAD83C-070192	9,664 chgs
Container, Fiber	9321285/B	PA82	Omega Contr Inc United Ammo Contr Inc	2-84 11-83	2,170 7,494
Box, Wood Packing (Preservative Treated)	9321290/B		Commercial Box & Lumber Co Inc	1-83	4,820

(MA-83L140-026, M456A2)

REMARKS: (SYMBOLS: *CHANGE IN PROCESS; **DEVIATION FROM DWG. OR SPEC.; ***UNUSUAL OCCURRENCES OR DIFFICULTIES)

1. MIL-C-63286 (AR)/A3/NOR A3T0013/NOR A3T0022.
2. Projectile as fired weight is 23.17 lbs. and Std. Dev. is .025.

DOT: AMMUNITION FOR CANNON WITH EXPLOSIVE PROJECTILES

Figure A-1. Ammunition data cards.

COMPONENT (CONT' FROM FRONT)	DRAWING NO.	MODEL	MANUFACTURER	DATE MFG LOT NO.	[illegible]
Cone	8597608		Envirotronics Inc	ENT83D001-007	2,597
				ENT83D001-008	7,067
Conduit	8597613		Polymer Corp	POC82X003-004	
Charge, Bursting	MIL-C-401	COMP B Gr A	Holston AAP	10-70 HOL-030-5319	9,664 chgs
Spike Assembly	9324000/K		A A I Corp	AAJ83H006-002	
Terminal, Wire	9323974		AMP Prod Inc	Unk	
Pad, Fuse Shock	8864416/G		Commonwealth Felt Co.	CFB83H161-001A	
Fuze PIBD, Assy	8799735	M509A2	Lone Star AAP	LS-83J011-002	1,907
				LS-83L011-003	7,757
Spring Contact	9327333		Sterling Spring Corp	SSP82F003-001	
Screw, Machine	9323855		Marshall Mfg Corp	MAM82B036-001	1,907
				MAM81J031-002	7,757
Lock Plug Assy	9327328		" " "	MAM82G037-014	1,907
				MAM82D037-001	4,665
				MAM82D037-002	3,092
Gasket "O" Ring	MS-9021-226/C		Precision Rubber Co	PRC82C001-001	
Fin & Boom Assy	8597611/N		Chamberlain Mfg Corp	CGO83C014-004	6,572
				CGO83D014-005	3,092
Obturator	9327293/B		Chamberlain Mfg Corp	Unk	
Tracer Assy	8860550	M13	Lone Star AAP	LS-83L071-002	9,664
Plug & Disc Assy	8597489		Chamberlain Mfg Corp	CGO83D014-005	7,516
				CGO83E014-006	1,748
Case, Cartridge	10522799/F	M148A1B1	Norris Ind	NOR83L019-033	1,380
(MA-83L140-026, M456A2)			(CONTINUED ON ATTACHED CARD)	NOR83N019-035	8,268

COMPONENT (CONT' FROM FRONT)	DRAWING NO.	MODEL	MANUFACTURER	DATE MFG LOT NO.	QUANTITY

REMARKS: (SYMBOLS: *CHANGES IN PROCESS: **DEVIATIONS FROM DWG. OR SPEC: ***UNUSUAL OCCURRENCES OR DIFFICULTIES)

<u>Additional Note</u>: <u>Lot MA-83L140-026, M456A2</u>

3. Wood pallets were inspected 100% for the presence of bark-free stock number W12-7071X.
4. The M30 propellant used in this lot was accepted on waiver per telecon between Tony Bruskas, DRSMC-QAM-A, and William Hunter, SMCMI-QA on 21 Oct 83..
5. The fuze lock plug assemblies utilized in this lot have "tarnish on the contact plate".
6. Some projectiles used in this lot were accepted on Waiver W23-01-3.

Figure A-1 (Cont'd).

ARMY DEPOT SURVEILLANCE RECORD For use of this form, see SB 742-1 The proponent agency is DARCOM.						Name of Installation MAAP	
NSN/PN 1315 01 023 7122-C508		Nomenclature Ctg, 105MM HEAT-T-MP M456A2					
Lot/Serial No. MA-83L140-026	Grade	Date Mfg 11/83	Explo Wt/Pkg 4.28#	Shelf Life Exp Dte		Wt/Cube 132# 3.3 Cu	Stg Comp Grp & QD Class (12)1.2E
DOT Name Ammunition for Cannon with Explosive Projectiles				DOT Class A		Packed 1/fbr cntr, 2 fbr cntrs/wd bx	
Component Nomenclature					Lot/Serial No.		
Alt/MWC Status							

Location	Qty	Cond Code	I L P	Location	Qty	Cond Code	I L P	Location	Qty	Cond Code	I L P

DODAC/PN	Due Dates: Inspection	Due Dates: Monitor	Due Dates: Cal/Load Test	Packed	Cond Code	Caliber	Lot/Serial No.

RECORD OF INSPECTION

Date	Type Insp.	Location	Conditions Encountered	Code Remarks
			MA-83L140-026	
4/13/84			Code A - Accepted per JPG Datacom Report 84-152, Bradfield/	Msg dtd 4/10/84, Status (9,639)
1/26/87	FMS	F-206	Code A - 40 rds, fbr cntrs & wd bxs insp IAW SB 742-2 show no defects, palletized f/outshipment, Fly/ Acceptable f/FMS per QASAS, K. Smith/	(3,260)

DA FORM 3022-R, 1 May 76 Previous Edition is Obsolete. (Paper size 8X10½" Image size 7X9½")

Figure A-2. Army depot surveillance record, DA Form 3022-R.

PROPELLANT DESCRIPTION SHEET

REPORTS CONTROL SYMBOL EXEMPT-PARA 7-2a AR 335-15

COMPOSITION M30 f/CTG HEAT-T-MP M456A2 f/105mm Gun	DA LOT NUMBER RAD83C-070192
SPECIFICATION TDPL MIL-P-46458 dated 24 Nov 81	PACKED AMOUNT 292,445 pounds
MFD AT RADFORD ARMY AMMUNITION PLANT, RADFORD, VA.	CONTRACT NUMBER DAAA09-77-C-4007

NITROCELLULOSE

ACCEPTED BLEND NUMBERS	NITROGEN CONTENT	KI STARCH (65.5°C)	STABILITY (134.5°C)
B-31,083; 084; 094; 098; 101; 102; 108; 109; 115; 117	MAX 12.68 %	___ MIN	___ MIN
	MIN 12.55 %	___ MIN	___ MIN
	AVG 12.58 %	45+ MIN	30+ MIN
			EXPLOSION ___ HR

MANUFACTURE OF SOLVENT PROPELLANT

0.22 POUNDS SOLVENT PER POUND NC/DRY WEIGHT INGREDIENTS CONSISTING OF 60 POUNDS ALCOHOL AND 40 POUNDS ACETONE PER 100 POUNDS SOLVENT PERCENTAGE REMIX TO WHOLE 24

TEMPERATURES °F FROM	TO	PROCESS—SOLVENT RECOVERY AND DRYING	TIME DAYS	HOURS
	AMBIENT	LOAD FORCED AIR DRY		
AMBIENT	140	INCREASE TEMPERATURE 5°F PER HOUR		
140	140	HOLD AT TEMPERATURE		31

TESTS OF FINISHED PROPELLANT

PROPELLANT COMPOSITION * CONSTITUENT	PERCENT FORMULA	PERCENT TOLERANCE	PERCENT MEASURED	STABILITY AND PHYSICAL TESTS	FORMULA	ACTUAL
NITROCELLULOSE	28.00	±1.30	27.58	HEAT TEST SP. 120°C	30 CC 60"	CC 60'+
NITROGLYCERIN	22.50	±1.00	22.93	NO FUMES	——	NF 1 hr
NITROGUANIDINE	47.70	±1.00	47.69	FORM OF PROPELLANT		CYLINDER
ETHYL CENTRALITE	1.50	±0.10	1.47	NO. OF PERFORATIONS	——	7
CRYOLITE	0.30	±0.10	0.33	BULK DENSITY,		
TOTAL	100.00		100.00	lb/cu.ft	63.0 MIN.	64.7
TOTAL VOLATILES	0.50	MAX.	0.25	(M456 CARTRIDGE CASE)		
GRAPHITE	0.2	MAX.	0.17			
*COMPUTED ON A TV AND GRAPHITE FREE BASIS.						

CLOSED BOMB

	LOT NUMBER	TEMP °F	RELATIVE QUICKNESS	RELATIVE FORCE
TEST	RAD83C-070192	+90	95.86 %	99.98 %
	RAD83C-070192	-40	91.21 %	98.23 %
	RAD83C-070192	+145	99.66%	100.84%
STANDARD	RAD-69903	+90	100.00%	100.00%

REMARKS
FIRED IN A NOMINAL SIZE 700CC CLOSED BOMB. TEST FOR INFORMATION ONLY.

PROPELLANT DIMENSIONS (INCHES)

	SPECIFICATION	DIE	FINISHED	MEAN VAR. IN % (Of Mean Dimensions) SPEC.	ACTUAL
LENGTH (L)		0.645	0.6364	6.25 MAX.	1.12
DIAMETER (D)		0.353	0.3152	3.125 Max	1.48
PERF. DIA. (d)		0.027	0.0252		
WEB					
INNER		0.0690	0.0582		
OUTER		0.0670	0.0612		
AVERAGE		0.0680	0.0597		
Web Difference in % of Web Avg.	15 MAX.		5		
L/D	2.00 to 2.20		2.02		
D/d	11.5 to 15		12.5		

DATES

PACKED	3-27-83
SAMPLED	3-27-83
TEST FINISHED	4-7-83
OFFERED	4-20-83
DESCRIPTION SHEETS FORWARDED	4-21-83

TYPE OF PACKING CONTAINER FIBER DRUMS PER MIL-STD-652D

REMARKS

THIS LOT MEETS ALL CHEMICAL AND PHYSICAL REQUIREMENTS OF THE APPLICABLE SPECIFICATION.

SIGNATURE OF CONTRACTOR'S REPRESENTATIVE	SIGNATURE OF GOVERNMENT QUALITY ASSURANCE REPRESENTATIVE
E. R. Lemon *E R Lemon*	JAMES E. BLAND *James E Bland*

ARRCOM FORM 214R 10 AUG 77

SEQUENCE No. 373

Figure A-3. Propellant description sheet.

TEST CONTROL OF VIBRATION SCHEDULES

The vibration schedules and controller parameters associated with this type of test are typed into a digital controller with the use of an interactive computer program residing within the digitial controller. The vibration spectrum information and control parameters are manipulated by the computer to form the control reference. After the controller estimates the transfer function of the control reference. After the controller estimates the transfer function of the entire system by sending out a signal and monitoring the return signal, the computer in the controller then convolves the transfer function and the reference to form a control signal.

The control signal is then passed to the power amplified which, in turn, powers the electrodynamic shaker. The test items experience the corresponding vibration through the table which is the mechanical interface between the test item and the moving element of the shaker. The accelerometers mounted near the test items were used to measure and control the acceleration input levels to the test items.

The acceleration measurements were made with combinations of the following types of piezoelectric accelerometers: Endevco 2233E, 2217E, 2272, 7703-50 and 7704-50. The change output from the accelerometer goes into an Unholtz-Dickie Model 122P charge amplifier which is set to convert the current signal to a voltage signal, and then automatically amplifies it to the appropriate level for input to an encoder. The encoder combines each analog signal into a single pulse code modulated signal which is transmitted through a long coaxial cable from the test cell to a Loral ADS 100 in the control room which decodes the single PCM signal into individual analog signals for input into a built-in multiplexer system (up to 16 channels) where the channels are sequentially time sampled and this composite signal is inputted as one signal into the digital controller. The resident software within the controller makes the comparison of this signal to the reference. The controller makes any necessary changes to the generated output control signal to maintain the acceleration levels within the prescribed limits of the reference.

The control of the vibration exciter, based on the acceleration measurement, was continuously maintained within ± 3 dB of the specified requirements by the digital vibration controller. If an error was to occur, or the computer controller could not maintain control within the limits of the specified spectrum acceleration levels, the computer would halt the test until the problem was corrected. Figure A-5 contains a simplified block diagram of the vibration control system.

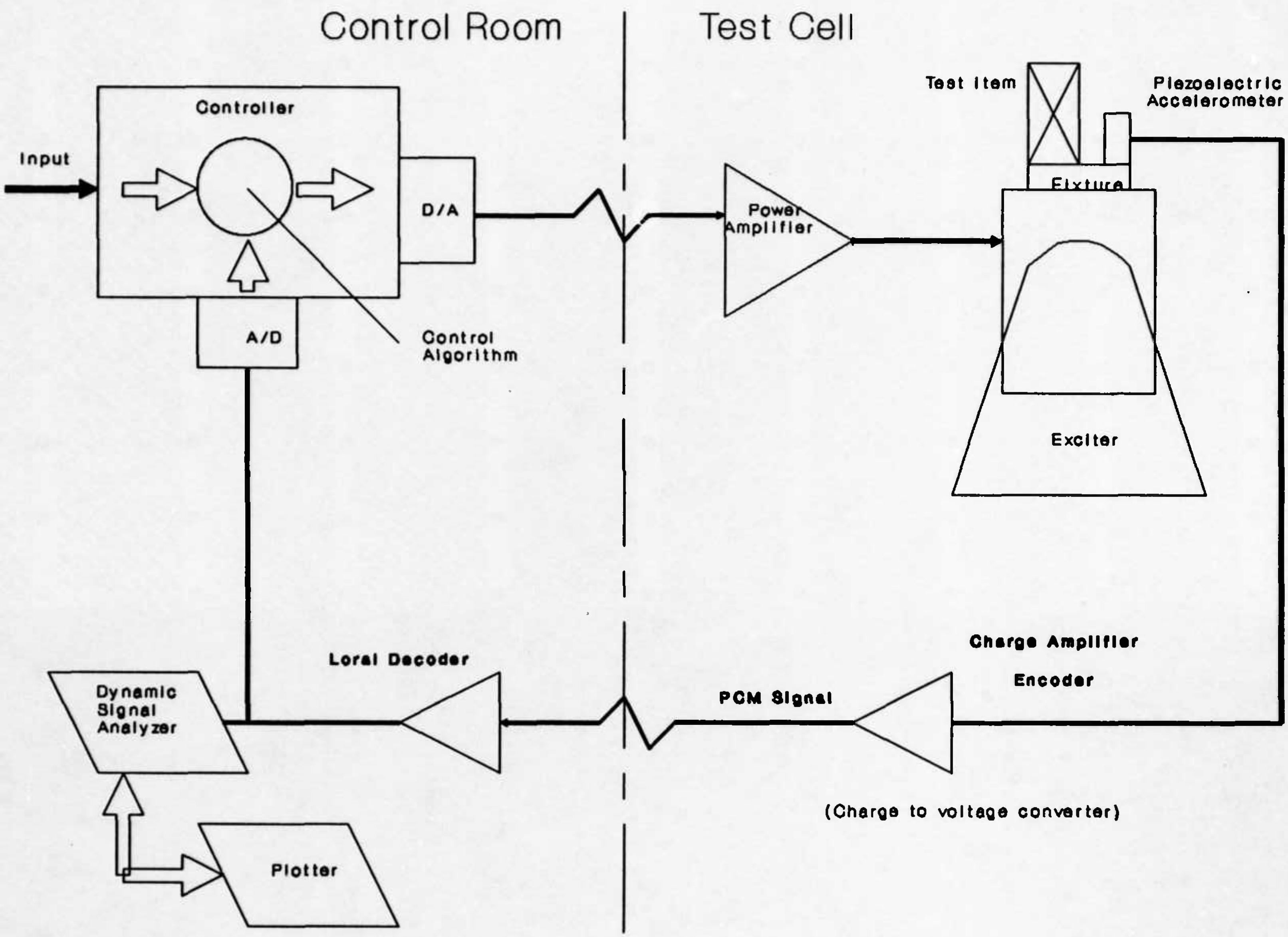


Figure A-4. Simplified block diagram of vibration control system.

TABLE A-1. NARROWBAND RANDOM-ON-RANDOM VIBRATION PROGRAM DATA FOR 105-MM AMMUNITION TRANSPORTED IN M1 TANK HULL RACK

							NARROWBAND 1			NARROWBAND 2			NARROWBAND 3			NARROWBAND 4			NARROWBAND 5		
Test Phase	5-500 Floor g2/Hz	No. Sweeps	AV	AWF	Overall RMS g	Time min	BW Hz	Ampl g2/Hz	Sweep BW Hz	BW Hz	Ampl g2/Hz	Sweep BW Hz	BW Hz	Ampl g2/Hz	Sweep BW Hz	BW Hz	Ampl g2/Hz	Sweep BW Hz	BW Hz	Ampl g2/Hz	Sweep BW Hz
										VERTICAL AXIS											
V1	.0014	5	11	3	1.03	45.0	23- 28	.0058	2	46- 56	.0143	5	69- 84	.0066	7	92-112	.0050	10	115-140	.0183	12
V2	.0020	3	12	3	1.27	45.0	33- 41	.0400	4	66- 82	.0172	8	99-123	.0084	12	132-164	.0103	16	165-205	.0091	20
V3	.0018	2	16	3	1.54	45.0	46- 56	.0349	5	92-112	.0257	10	138-168	.0371	15	184-224	.0182	20	230-280	.0111	25
V4	.0026	2	10	4	3.00	45.0	60- 74	.2218	7	120-148	.2574	14	180-222	.0894	21	240-296	.0257	28	300-370	.0062	35
V5	.0037	1	18	2	3.78	45.0	79- 97	.3746	9	158-194	.3076	18	237-291	.0743	27	316-388	.0492	36	395-485	.0052	45
										TRANSVERSE AXIS											
T1	.0009	5	10	4	.76	45.0	14- 28	.0103	7	28- 56	.0059	14	-------	-----	--	-------	-----	--	-------	-----	--
T2	.0012	3	12	3	.95	45.0	33- 41	.0337	4	66- 82	.0050	8	99-123	.0030	12	132-164	.0050	16	165-205	.0046	20
T3	.0013	2	16	3	1.12	45.0	46- 56	.0299	5	92-112	.0175	10	138-168	.0101	15	184-224	.0086	20	230-280	.0028	25
T4	.0020	2	10	4	2.04	45.0	60- 74	.0701	7	120-148	.0956	14	180-222	.0349	21	240-296	.0224	28	300-370	.0056	35
T5	.0039	1	18	2	2.96	45.0	79- 97	.1227	9	158-194	.1330	18	237-291	.0457	27	316-388	.0625	36	395-485	.0081	45
										LONGITUDINAL AXIS											
L1	.0015	5	10	4	.92	45.0	14- 28	.0101	7	28- 56	.0042	14									
L2	.0019	3	12	3	1.16	45.0	33- 41	.0278	4	66- 82	.0046	8	99-123	.0036	12	132-164	.0076	16	165-205	.0100	20
L3	.0020	2	16	3	1.47	45.0	46- 56	.0278	5	92-112	.0217	10	138-168	.0131	15	184-224	.0275	20	230-280	.0088	25
L4	.0031	2	10	4	2.75	45.0	60- 74	.0558	7	120-148	.1020	14	180-222	.0432	21	240-296	.0520	28	300-370	.0617	35
L5	.0045	1	18	2	3.98	45.0	79- 97	.2687	9	158-194	.1249	18	237-291	.0862	27	316-388	.1426	36	395-485	.0466	45

The exaggeration factor was 2.0.

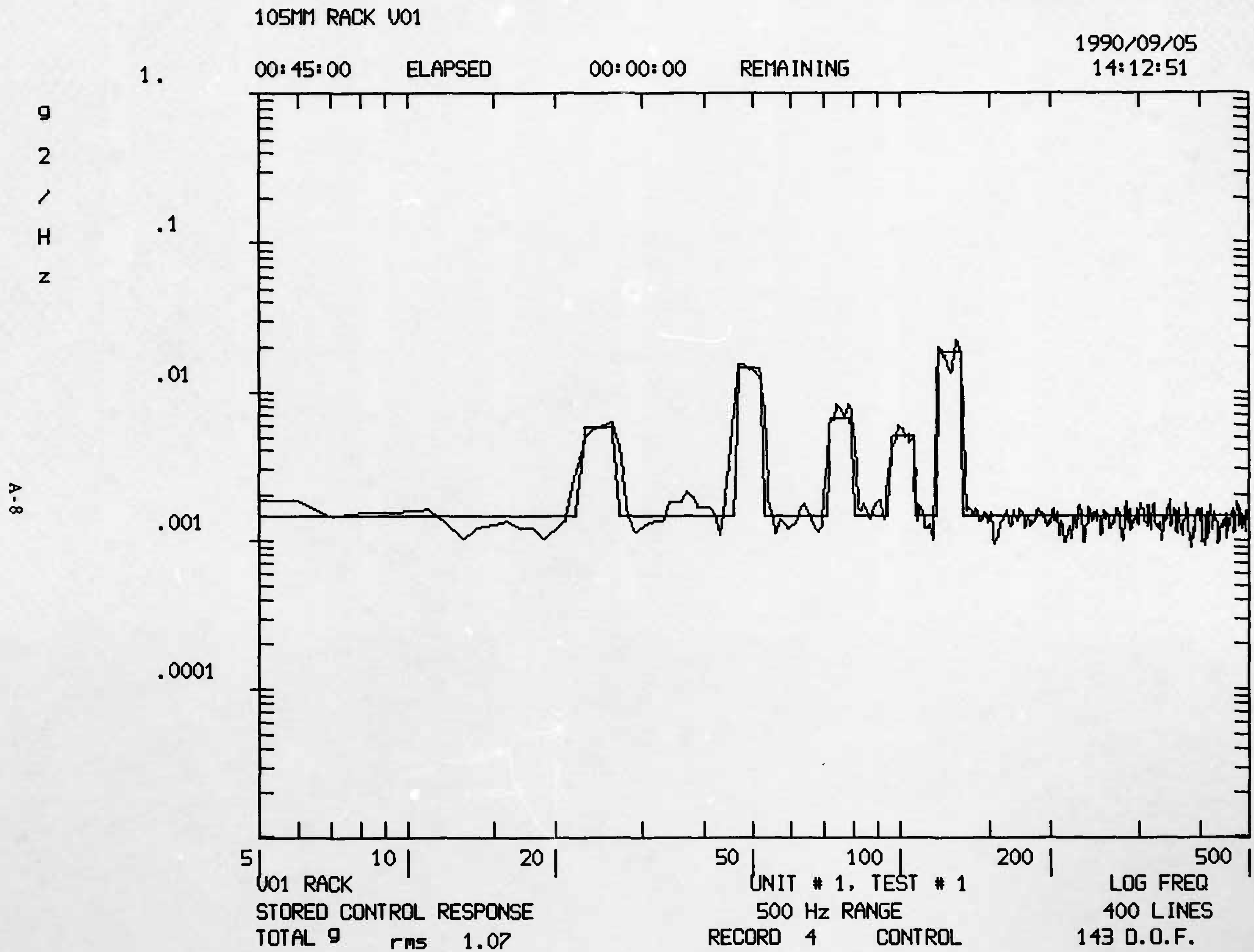


Figure A-5. Installed-equipment (rack) vibration schedule.

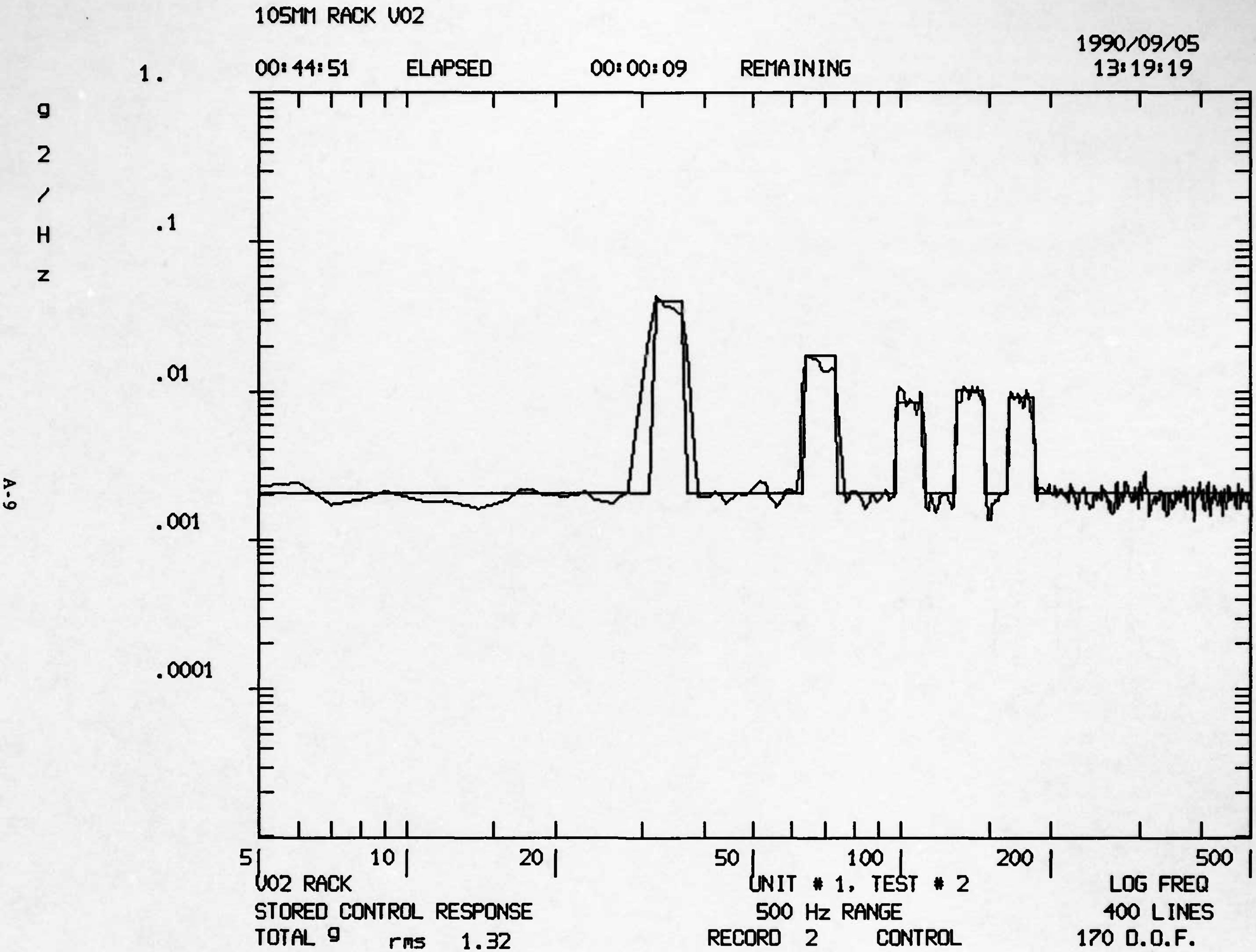


Figure A-6. Installed-equipment (rack) vibration schedule.

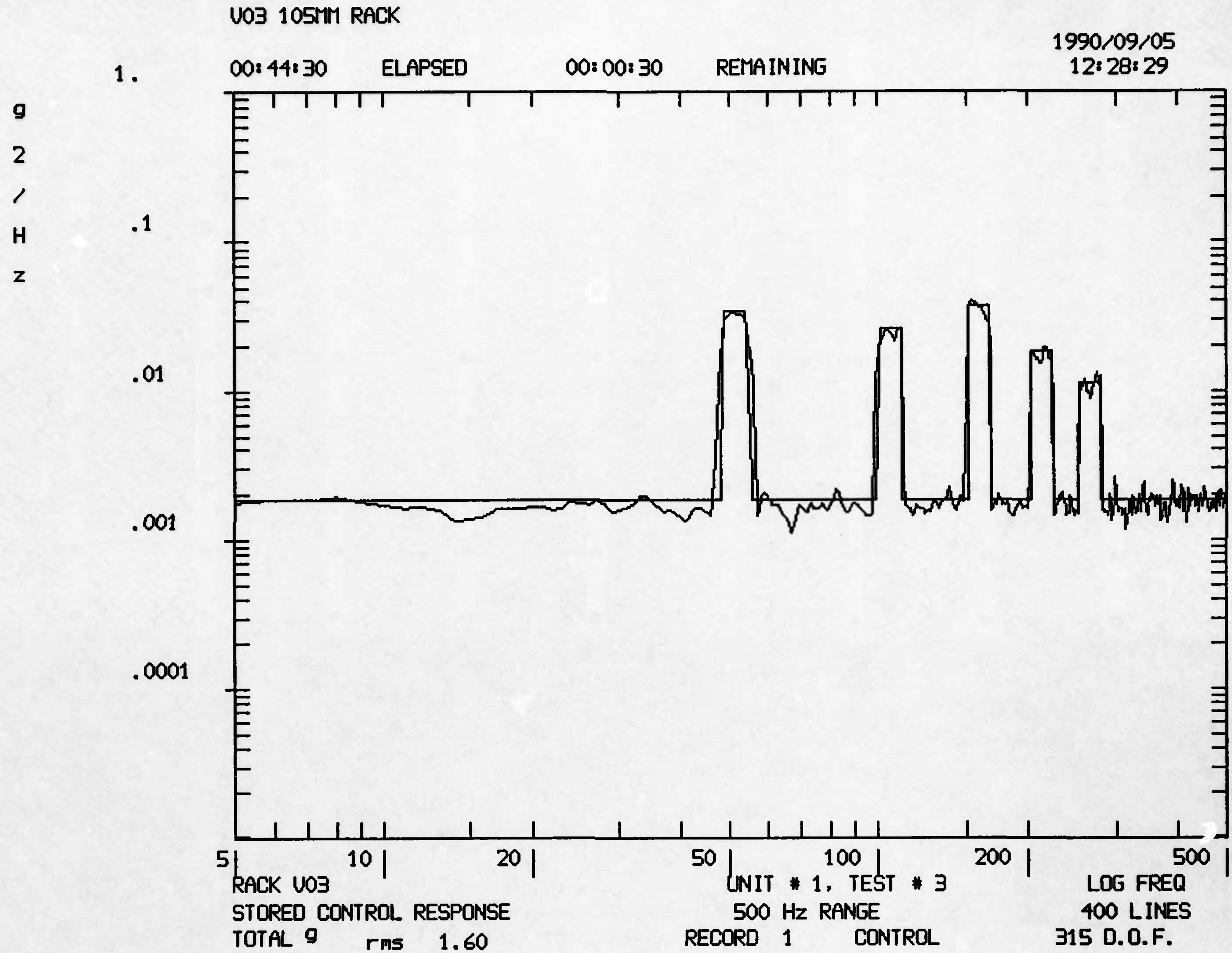


Figure A-7. Installed-equipment (rack) vibration schedule.

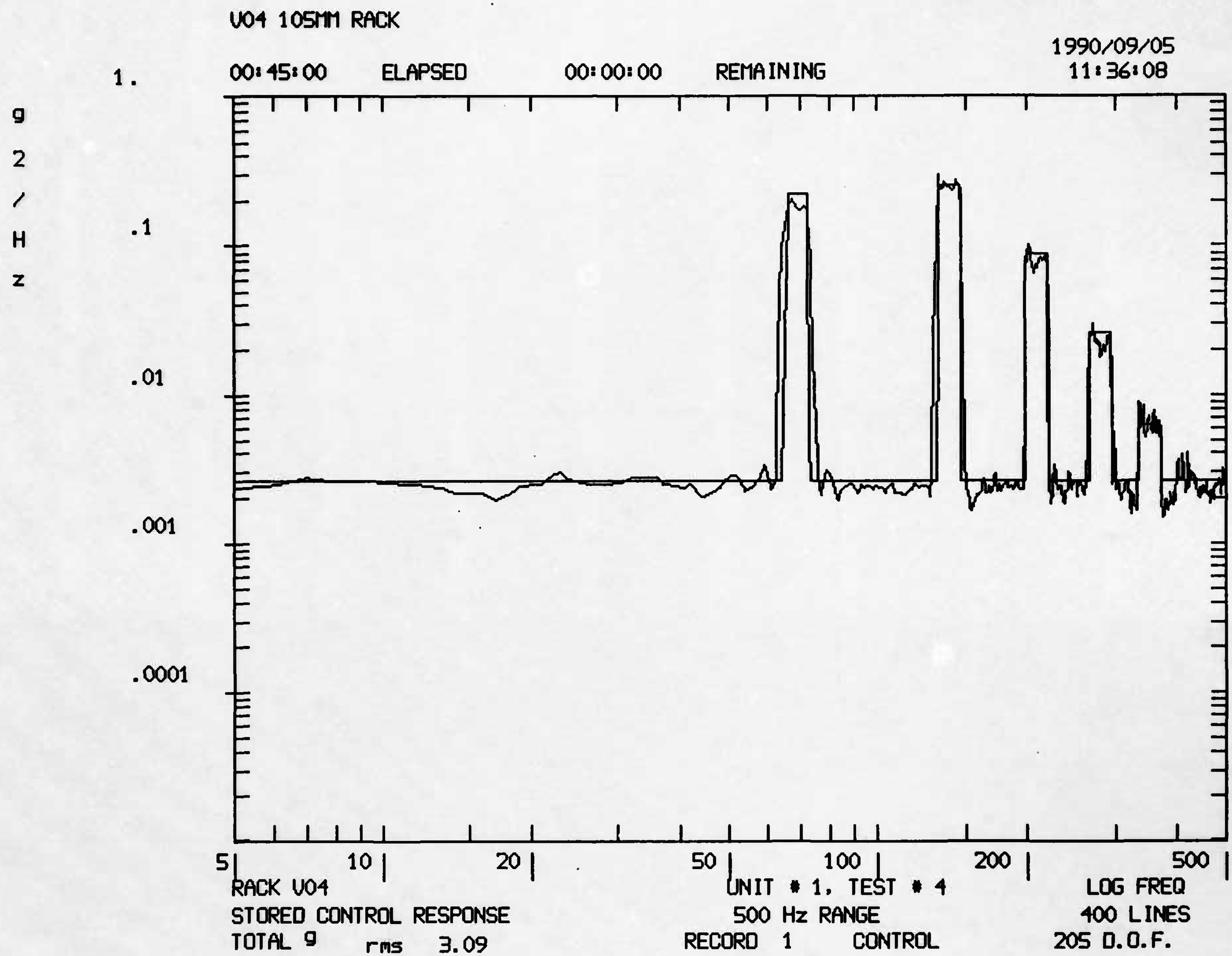


Figure A-8. Installed-equipment (rack) vibration schedule.

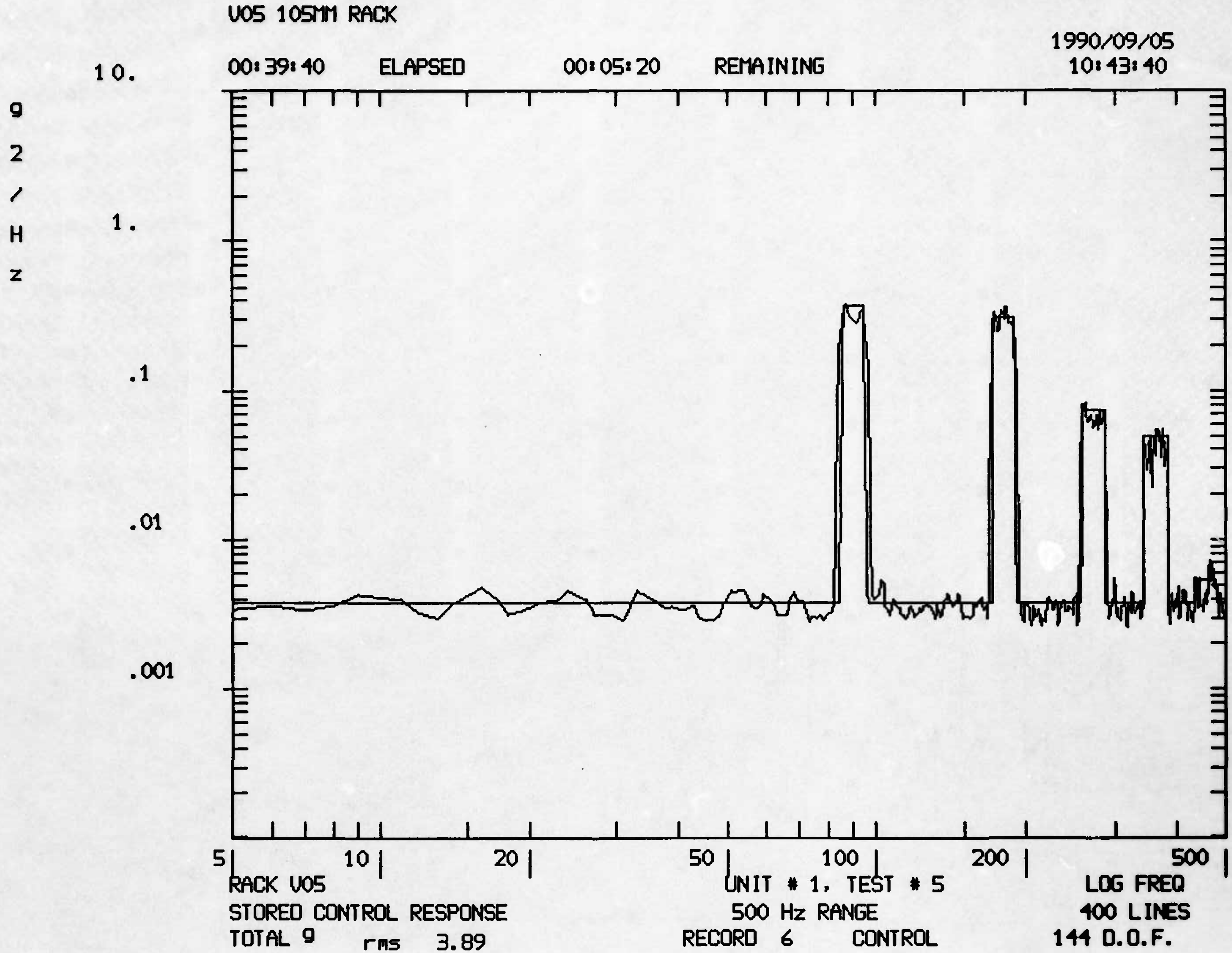


Figure A-9. Installed-equipment (rack) vibration schedule.

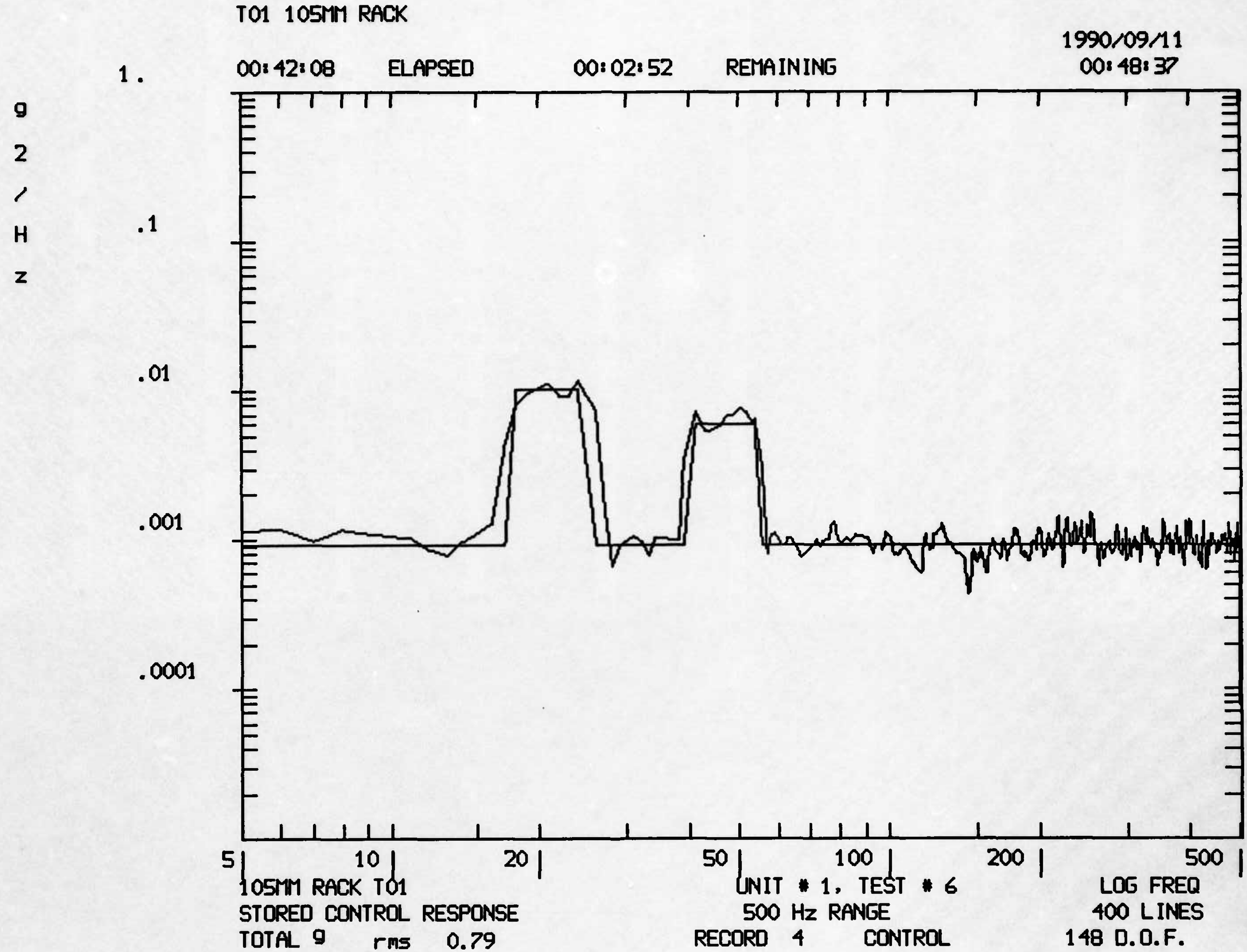


Figure A-10. Installed-equipment (rack) vibration schedule.

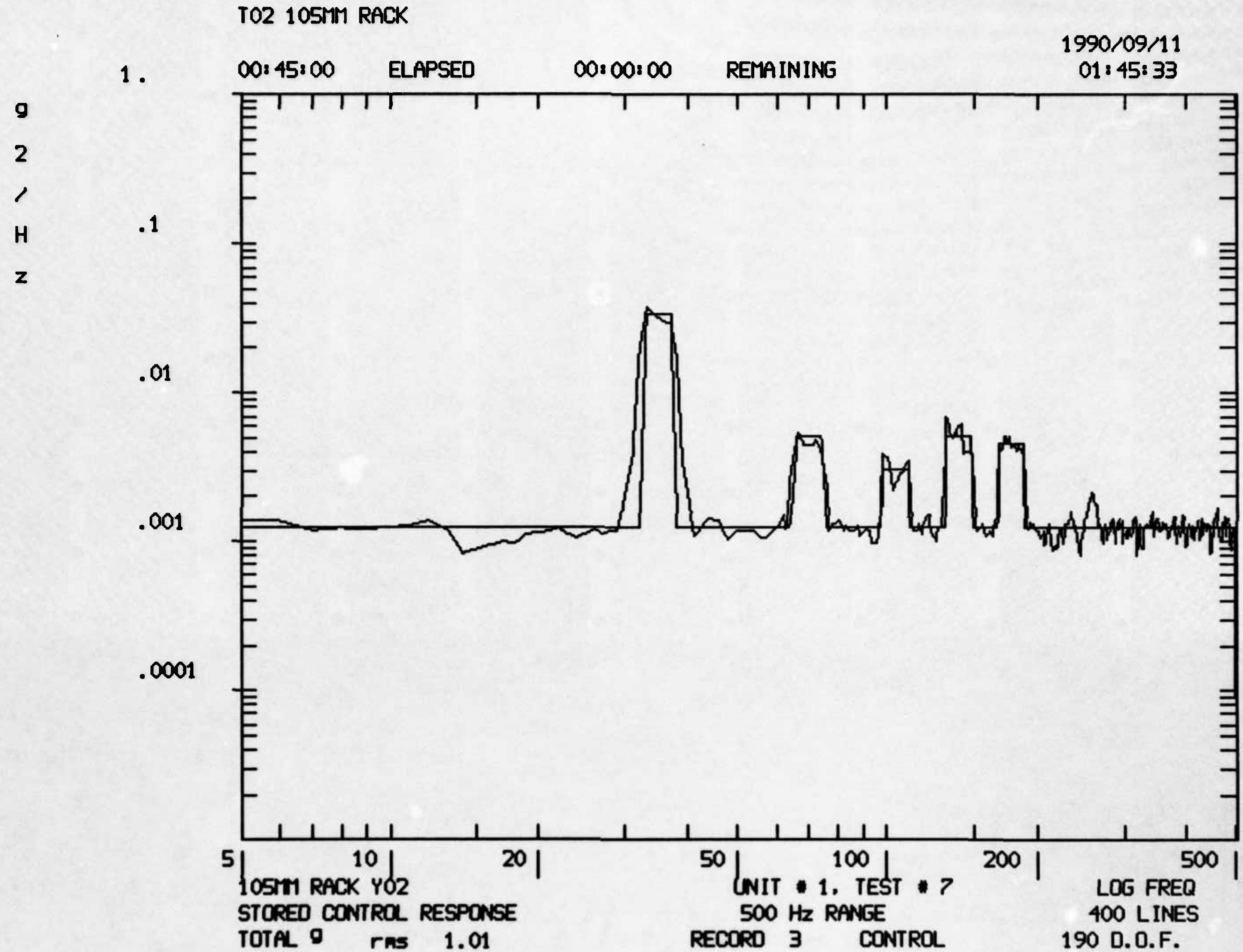


Figure A-11. Installed-equipment (rack) vibration schedule.

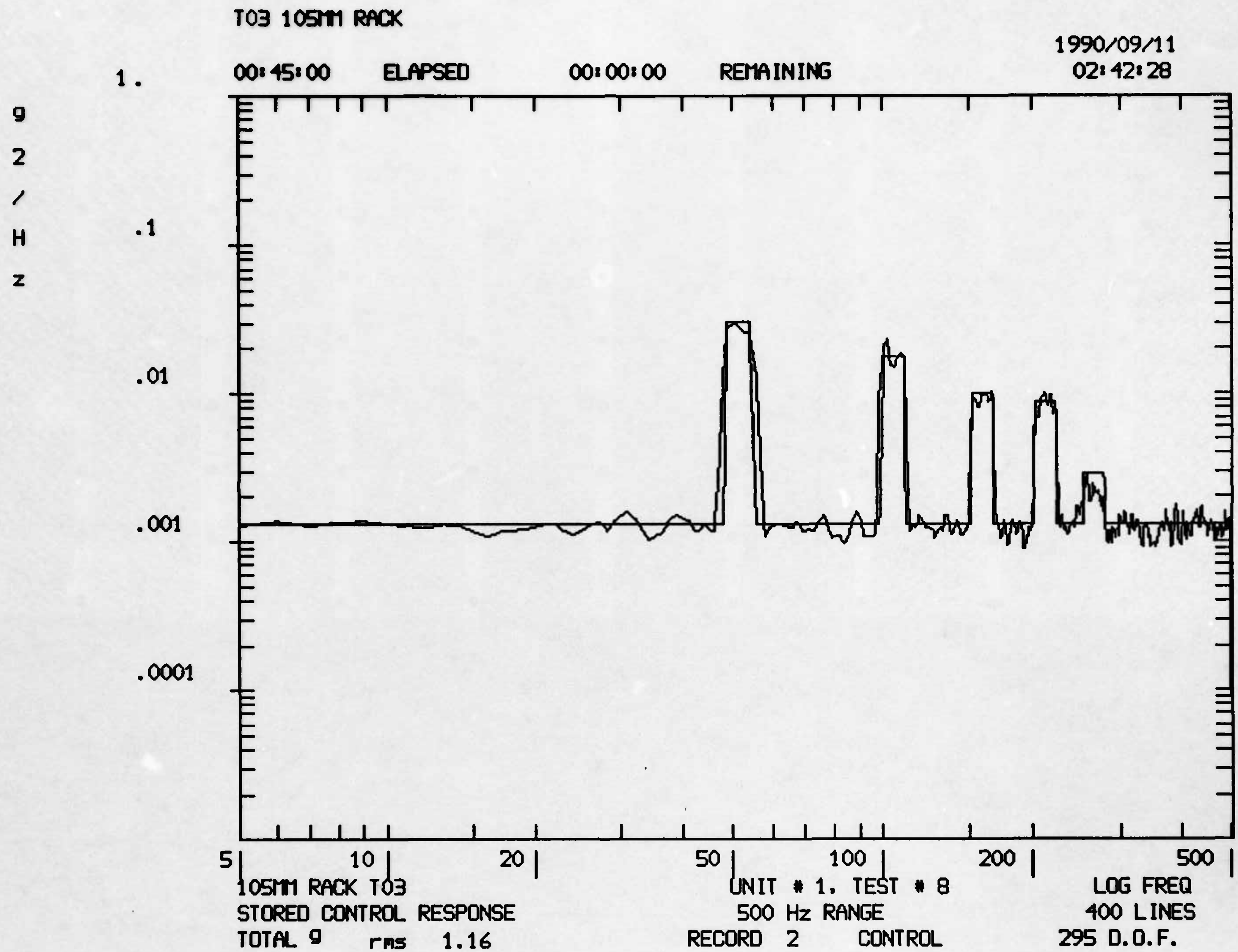


Figure A-12. Installed-equipment (rack) vibration schedule.

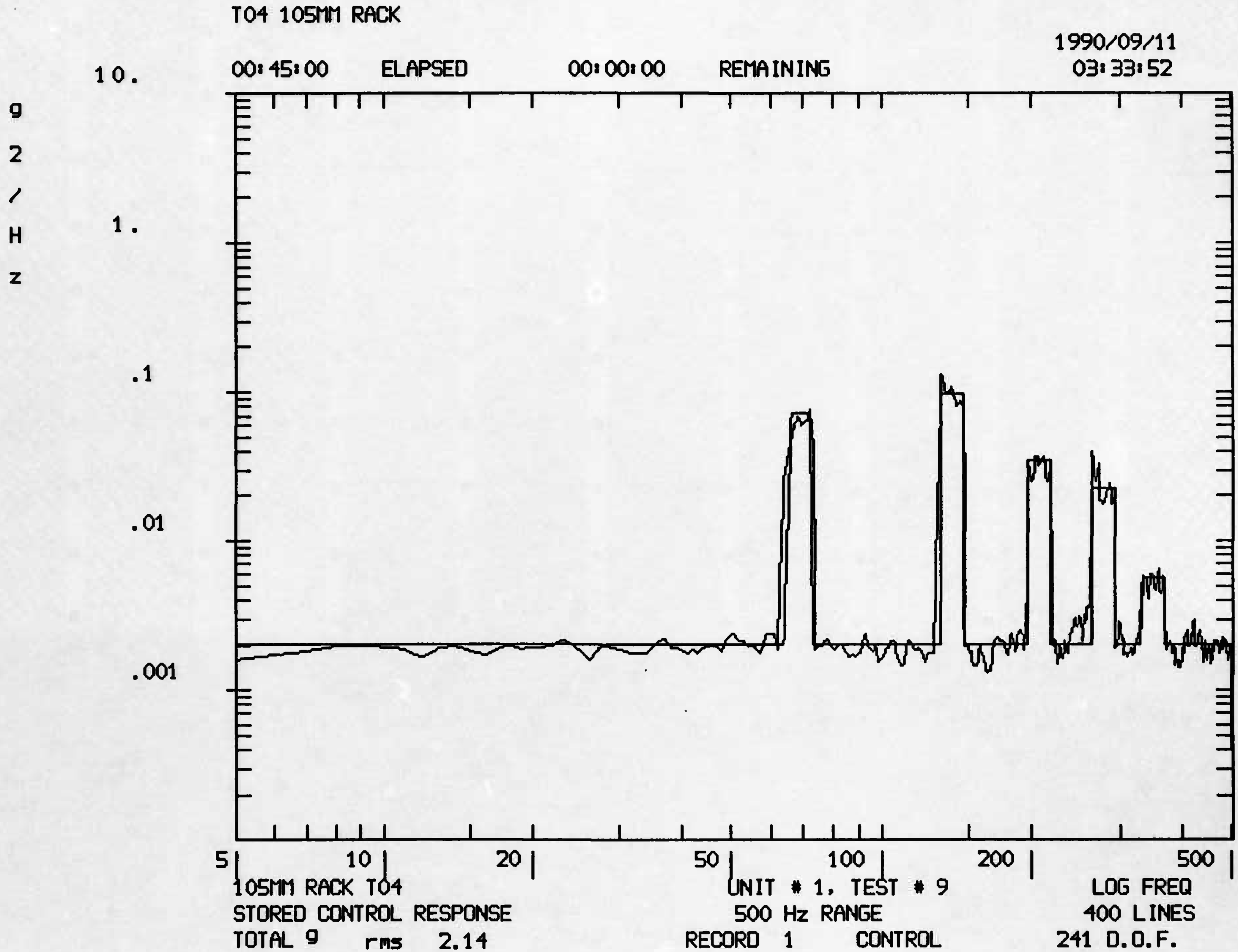


Figure A-13. Installed-equipment (rack) vibration schedule.

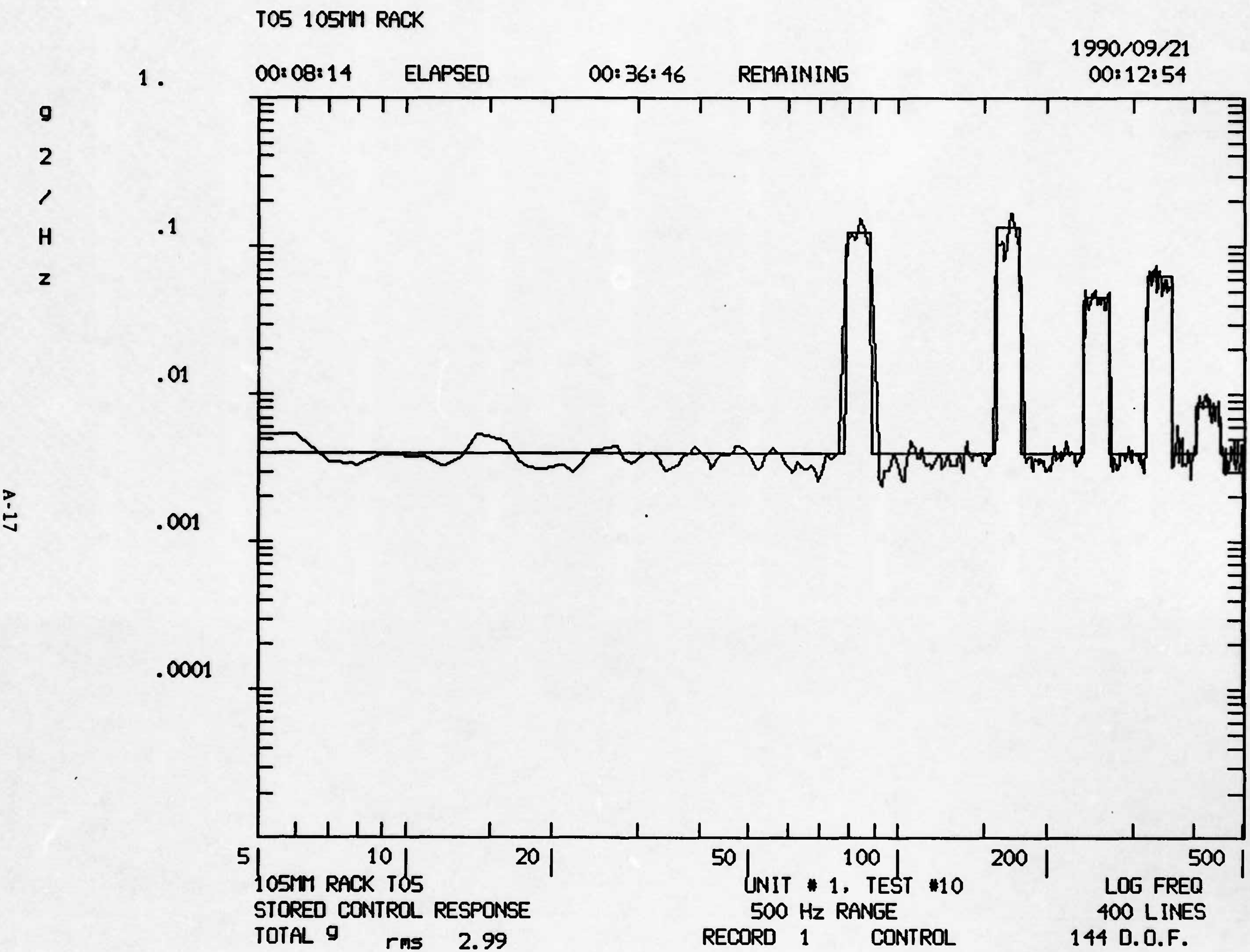


Figure A-14. Installed-equipment (rack) vibration schedule.

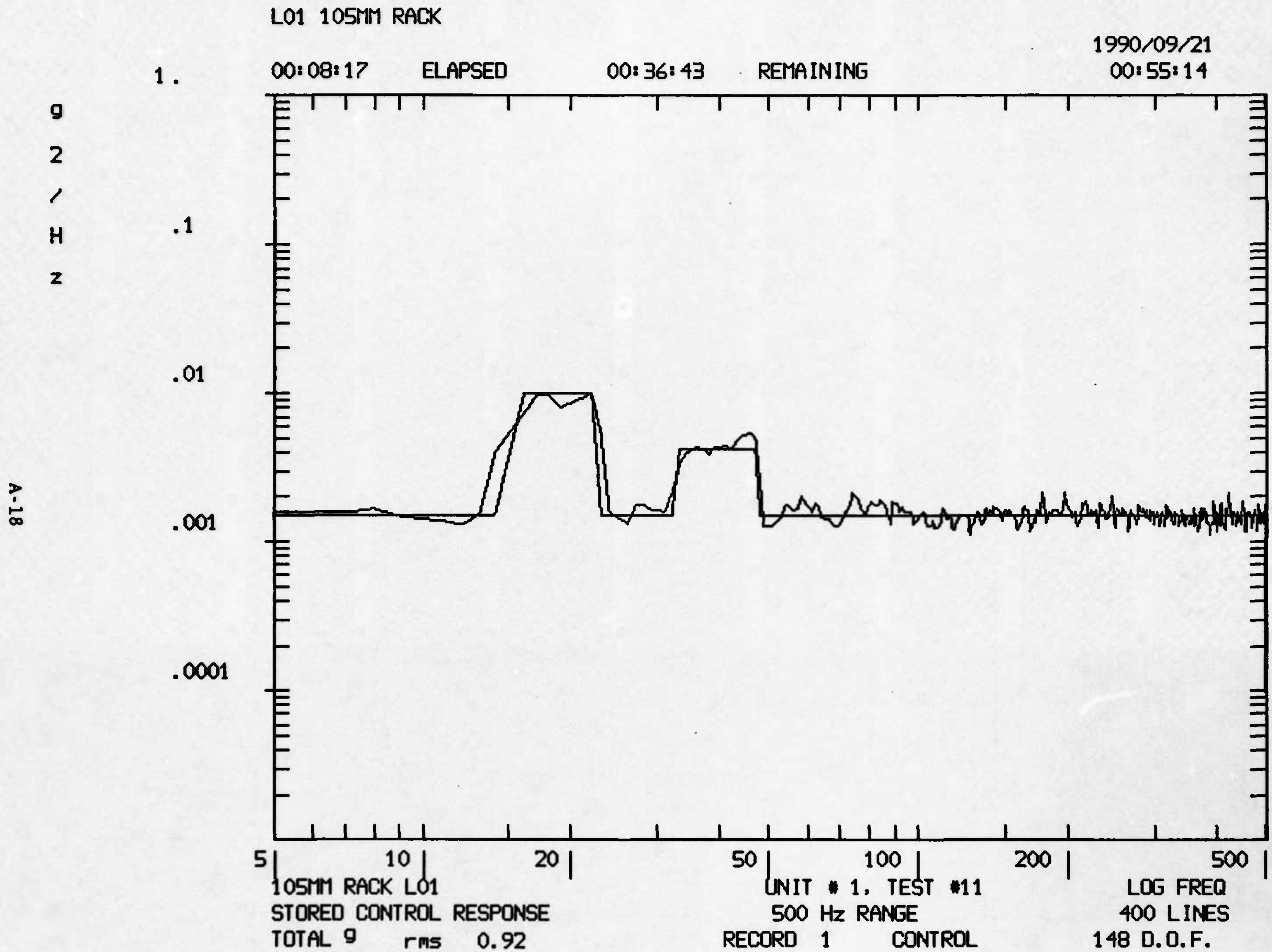


Figure A-15. Installed-equipment (rack) vibration schedule.

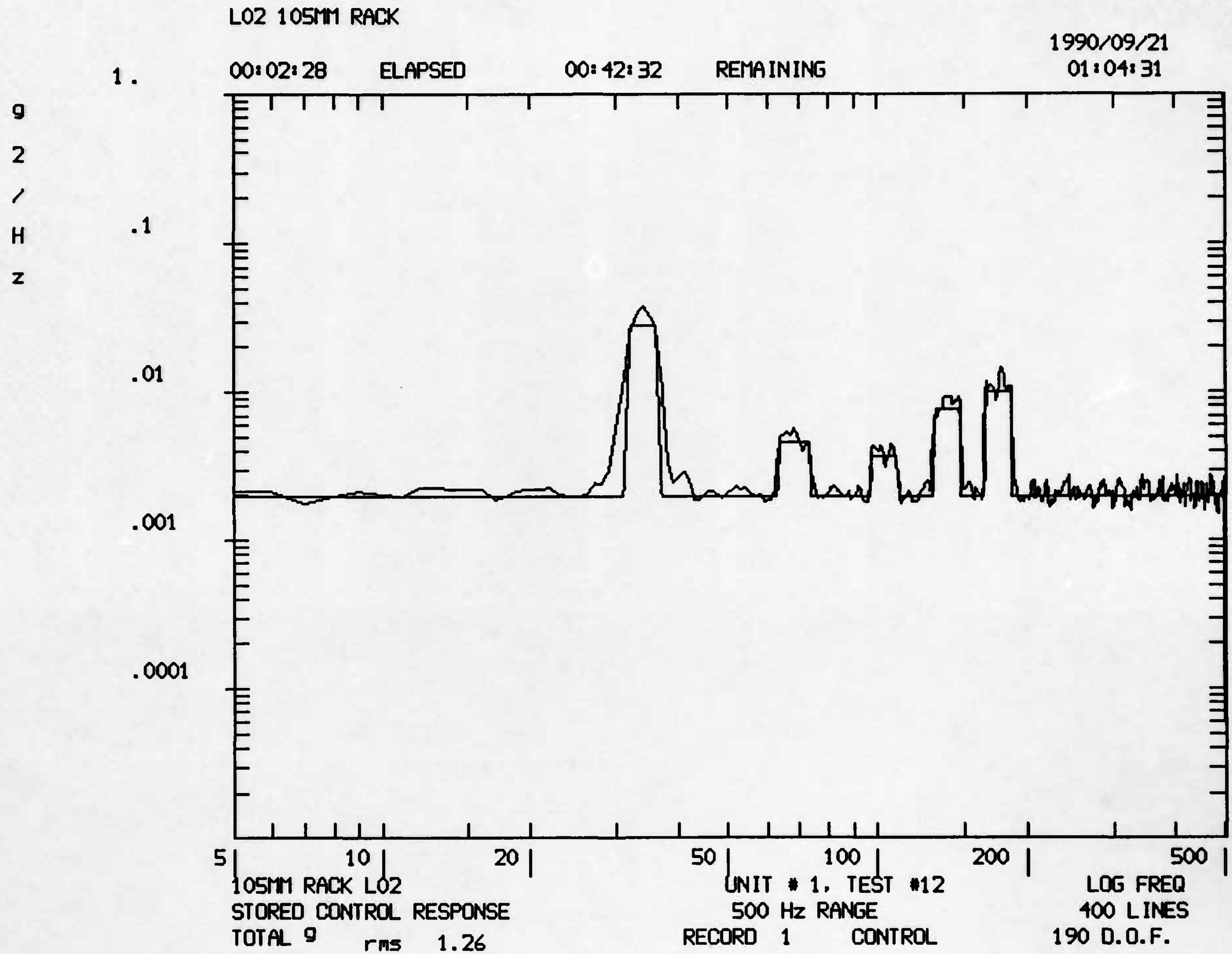


Figure A-16. Installed-equipment (rack) vibration schedule.

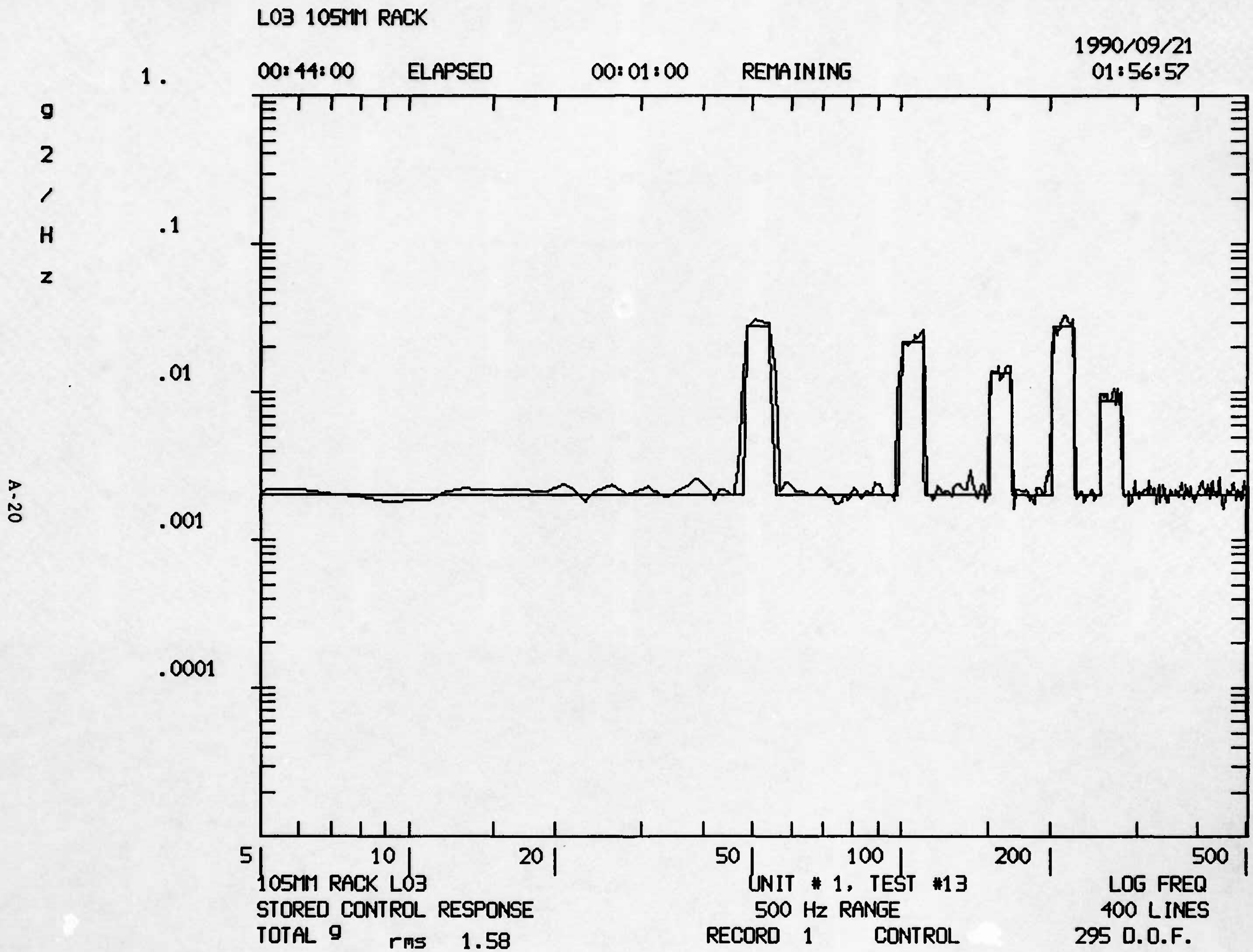


Figure A-17. Installed-equipment (rack) vibration schedule.

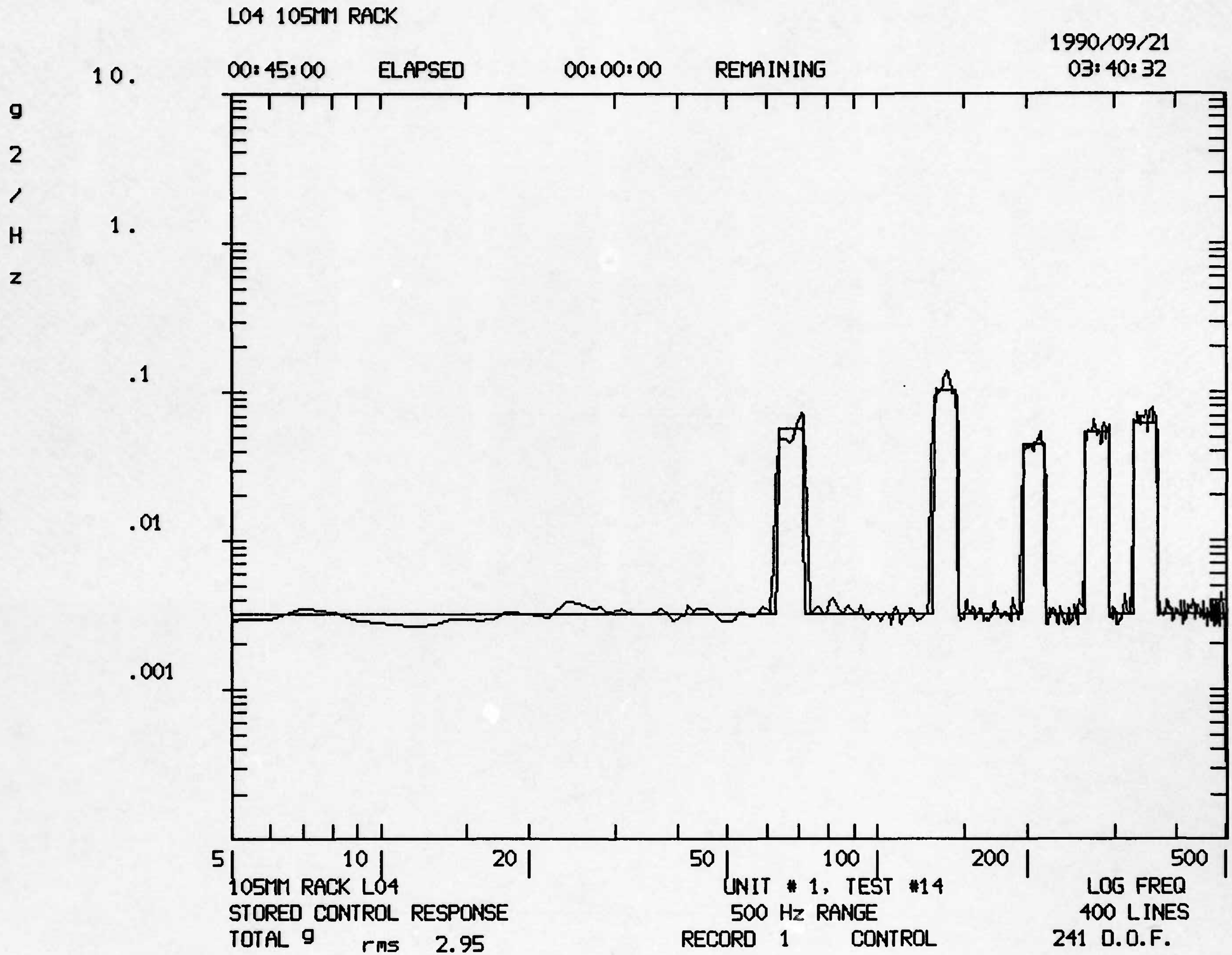


Figure A-18. Installed-equipment (rack) vibration schedule.

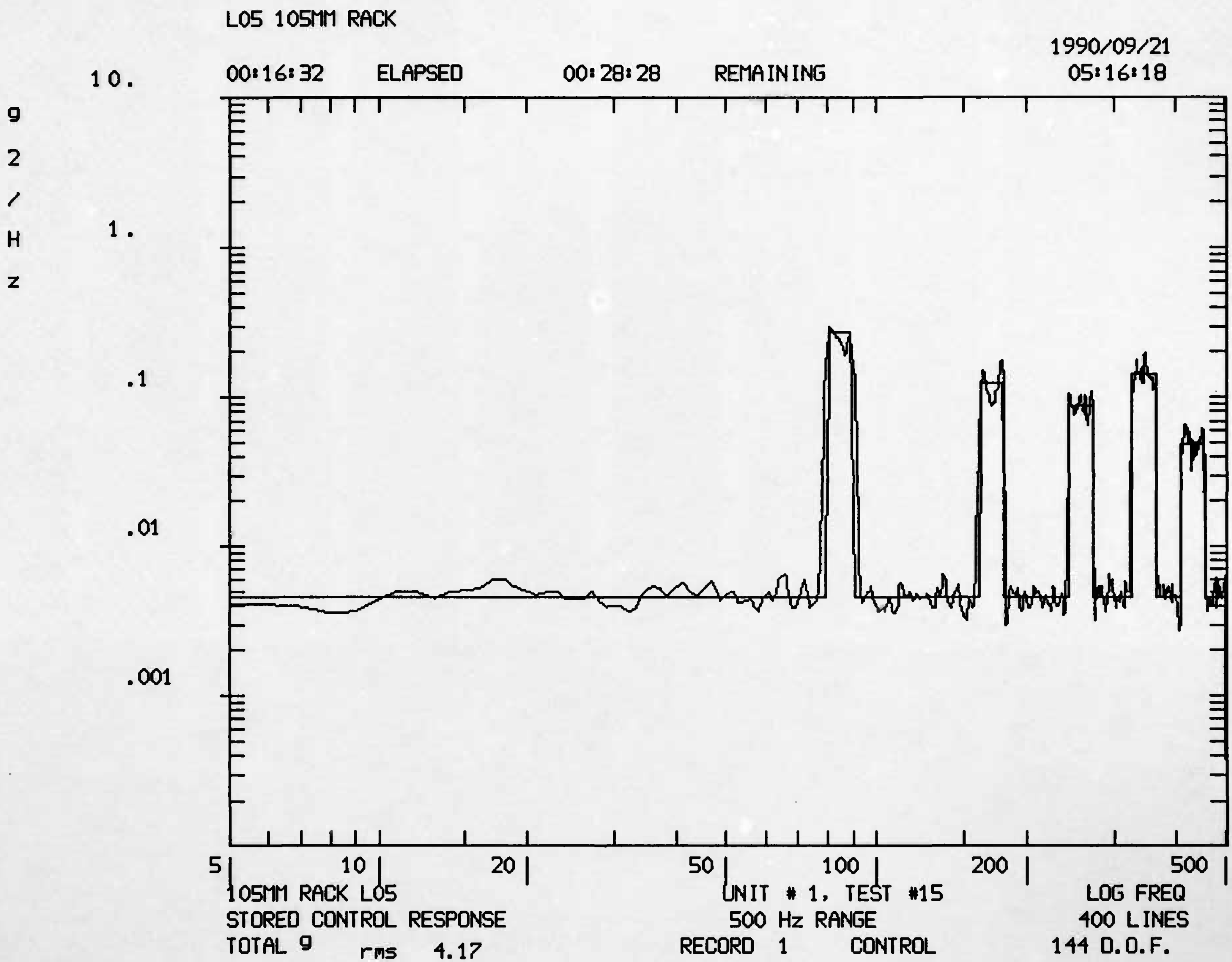
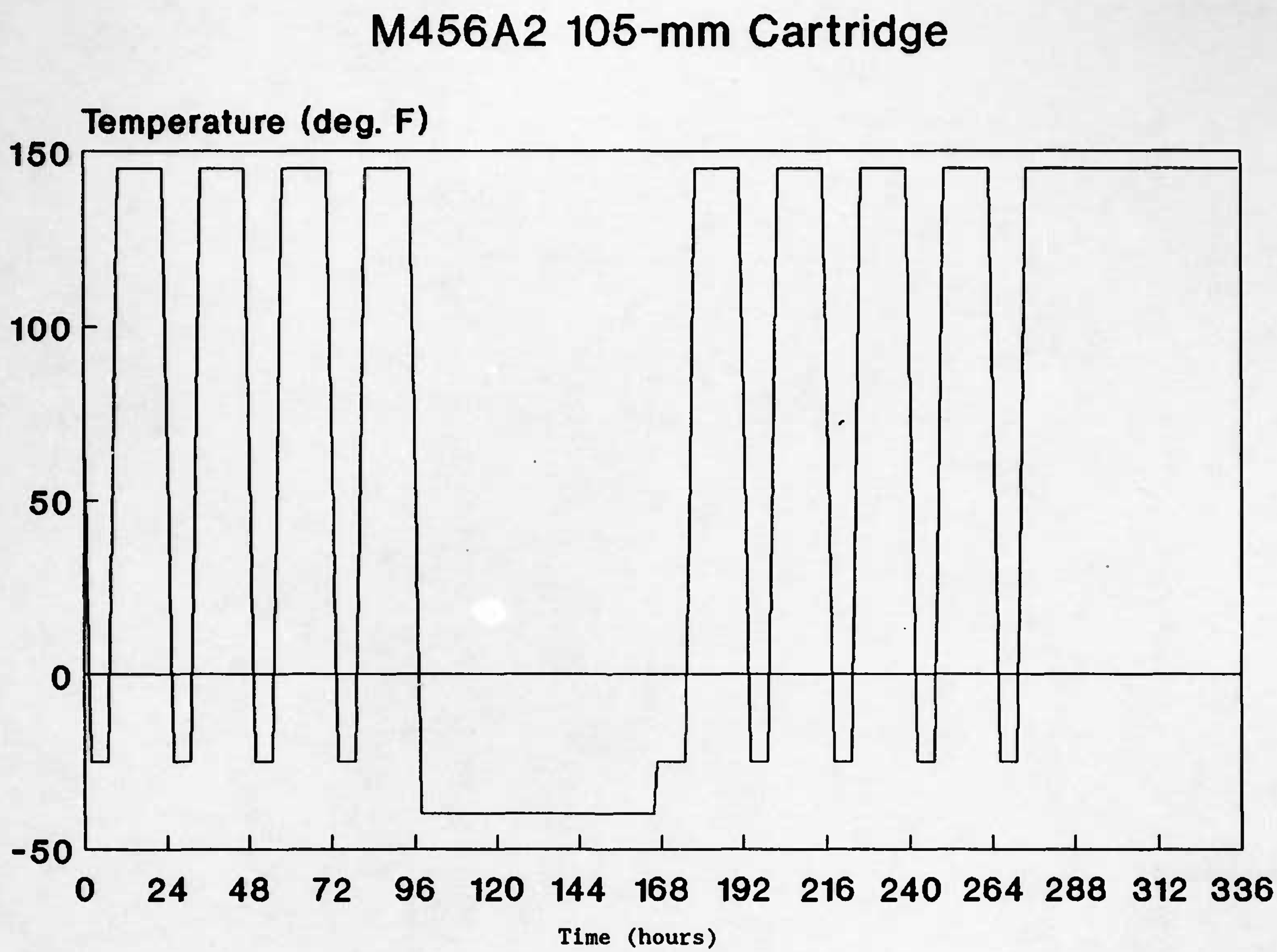


Figure A-19. Installed-equipment (rack) vibration schedule.



1. Above 21 ^{o}C (70 ^{o}F) the humidity was gradually increased from 75 to 95 percent.
2. Humidity was maintained at 95% when temperatures were 63 ^{o}C (145 ^{o}F).
3. Time tolerances were 15 minutes for all periods of temperature change.
4. Below 21 ^{o}C (70 ^{o}F) the humidity was turned off (humidity within chamber was uncontrolled below 21 ^{o}C).

Figure A-20. Temperature/humidity cycle.

RESULTS OF MOISTURE CONTENT ANALYSIS

MEMORANDUM FOR: Chief, Armament Materials Branch

SUBJECT: Moisture content of M30 Propellant Samples For Corrosion Investigation

1. References: MIL-STD-286C, Method T103.5.2 Total Volatiles (Gas Chromatography Method).

2. USACSTA is currently testing the 105-mm, HEAT-T-MP, M456A2 cartridge with M30 propellent (lot No. MA83L140-026). Thirty samples of M30 propellant and fifteen samples of Benite primer were analyzed for moisture in the laboratory. Quantitative analysis of the moisture content is reported below.

3. The samples were analyzed by MIL-STD-286C method T103.5.2 for moisture. This method uses gas chromatography (see A-25 for an explanation of gas chromatography). Method T103.5.2 calls for 10 grams of propellant to be used in the analysis. Of the fifteen benite primer samples submitted to the laboratory, only sample A90-0825 contained 10 grams of sample; the benite sample sizes ranged from 4.4 to 10.0 grams. The moisture in the multi-base M30 propellent samples, containing nitrocellulose of approximately 12.60 percent nitrogen, was extracted with 20 percent methyl ethyl ketone (MEK)/80 percent sec-butanol. The multi base M30 propellant samples were analyzed using a 0.6-meter (2-ft) Poropak Q column at 125 ^{o}C (257 ^{o}F), helium flow rate of 60 cm^3/min, injector at 140 ^{o}C (284 ^{o}F), and thermal conductivity detector (TCD) at 140 ^{o}C. The moisture in the single base benite primer samples, containing nitrocellulose of approximately 13.15 percent nitrogen, was extracted with 25 percent MEK/75 pecent sec-butanol. The single-base benite samples were analyzed using an 2.4-meter (8-ft) Poropak Q column at 150 ^{o}C (302 ^{o}F), helium flow rate of 60 cm^3/min, injector at 170 ^{o}C (338 ^{o}F), and TCD at 180 ^{o}C (302 ^{o}F). Tables A-2 and A-3 give a description of the samples and the moisture content.

4. The moisture content of the propellent samples, with the exception of samples A90-0818, -0820, -0953, -1010, and -1011 was within the specification for total volatiles on the propellant description sheet (0.5 percent maximum). The moisture content of the primer samples, with exception of samples A90-1015, -1016 and -1017, was within the measured value for moisture (1.00 percent maximum) found in section 3.4 of the Military Specification for Benite Strands.

5. The composition break down of Samples A90-1047, black powder from base of shot No. 10 primer was not analyzed due to insufficient quantity.

Analytical Method: Gas Chromatography

Gas chromatography is a chemical analysis technique used for separation and quantitation of gases and liquids. The instrumentation used to do gas chromatography is a gas chromatograph. A typical gas chromatograph consists of four main parts:

1. Sample introduction system (injector)
2. Separation column
3. Detection system (detector)
4. Data collection and reduction system (computer)

(See Figure 1).

The sample is usually injected into a gas chromatograph by a syringe. Only small amounts of sample are used (typically less than 10 microLiters for liquids, 1 cc for gases) for each analysis. The sample is moved from the injection system to the separation column by a flow of helium gas. As the sample moves through the column, it is separated into its component parts

The separated components are then moved by the helium gas from the separation column to the detection system. The detector "sees" the components by responding to their thermal conductivity, ability to be ionized, or by their infrared absorption patterns. The response from the detector is usually printed out as peaks where each peak represents a unique compound. The area or height of the peaks can be used to determine the amount of each component present in the sample.

To quantitate a component a pure standard is needed. Standards are analyzed separately from the sample. Injection of standards that are above and below the concentration of the sample are needed for accurate quantitation.

References: Basic Relationships of Gas Chromatography by L.S.Ettre

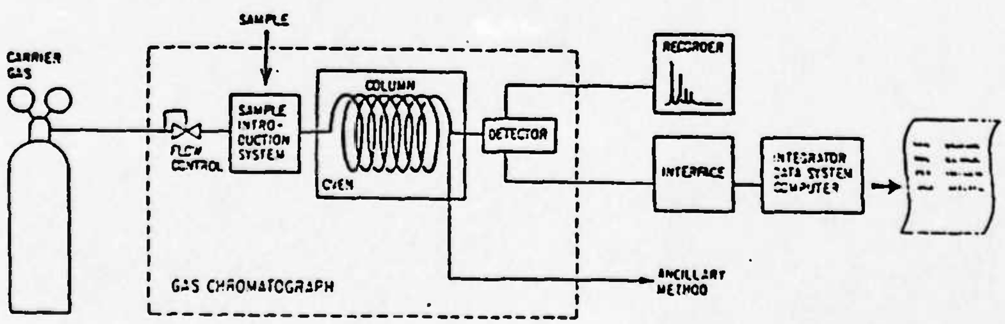


Figure 1 - Basic components of a gas chromatographic system.

TABLE A-2. RESULTS OF PROPELLANT ANALYSIS

Sample No.	Date, 1990	Cartridge No. and Location of Sample	Percent Moisture
A90-0809	4 Sep	3 Top	0.32
A90-0810	4 Sep	3 Middle	.29
A90-0811	4 Sep	3 Bottom	.27
A90-0812	4 Sep	4 Top	.35
A90-0813	4 Sep	4 Middle	.35
A90-0814	4 Sep	4 Bottom	.32
A90-0815	4 Sep	9 Top	.37
A90-0816	4 Sep	9 Middle	.31
A90-0817	4 Sep	9 Bottom	.27
A90-0818	4 Sep	10 Top	.55
A90-0819	4 Sep	10 Middle	.48
A90-0820	4 Sep	10 Bottom	.52
A90-0951	12 Sep	5 Top	.27
A90-0952	12 Sep	5 Middle	.32
A90-0953	12 Sep	5 Bottom	.68
A90-0954	12 Sep	6 Top	.20
A90-0955	12 Sep	6 Middle	.15
A90-0956	12 Sep	6 Bottom	.19
A90-0988	1 Oct	1 Top	.28
A90-0989	1 Oct	1 Middle	.28
A90-0990	1 Oct	1 Bottom	.31
A90-0991	1 Oct	2 Top	.31
A90-0992	1 Oct	2 Middle	.31
A90-0993	1 Oct	2 Bottom	.31
A90-1009	9 Oct	7 Top	.47
A90-1010	9 Oct	7 Middle	.57
A90-1011	9 Oct	7 Bottom	.61
A90-1012	9 Oct	8 Top	.41
A90-1013	9 Oct	8 Middle	.39
A90-1014	9 Oct	8 Bottom	.42

TABLE A-3. RESULTS OF STRAND BENITE ANALYSIS

Sample No.	Date, 1990	Cartridge No. and Location of Sample	Percent Moisture
A90-0957	12 Sep	5 Top primer	0.95
A90-0958	12 Sep	5 Middle primer	0.99
A90-0959	12 Sep	5 Bottom primer	0.97
A90-0994	1 Oct	2 Top primer	0.89
A90-0995	1 Oct	2 Middle primer	1.00
A90-0996	1 Oct	2 Bottom primer	0.80
A90-0821	5 Sep	3 Top primer	0.76
A90-0822	5 Sep	3 Middle primer	0.83
A90-0823	5 Sep	3 Bottom primer	0.86
A90-0824	5 Sep	9 Top primer	0.94
A90-0825	5 Sep	9 Middle primer	0.94
A90-0826	5 Sep	9 Bottom primer	0.84
A90-1015	1 Oct	7 Top primer	1.30
A90-1016	1 Oct	7 Middle primer	1.55
A90-1017	1 Oct	7 Bottom primer	1.62

APPENDIX B. PHOTOGRAPHS

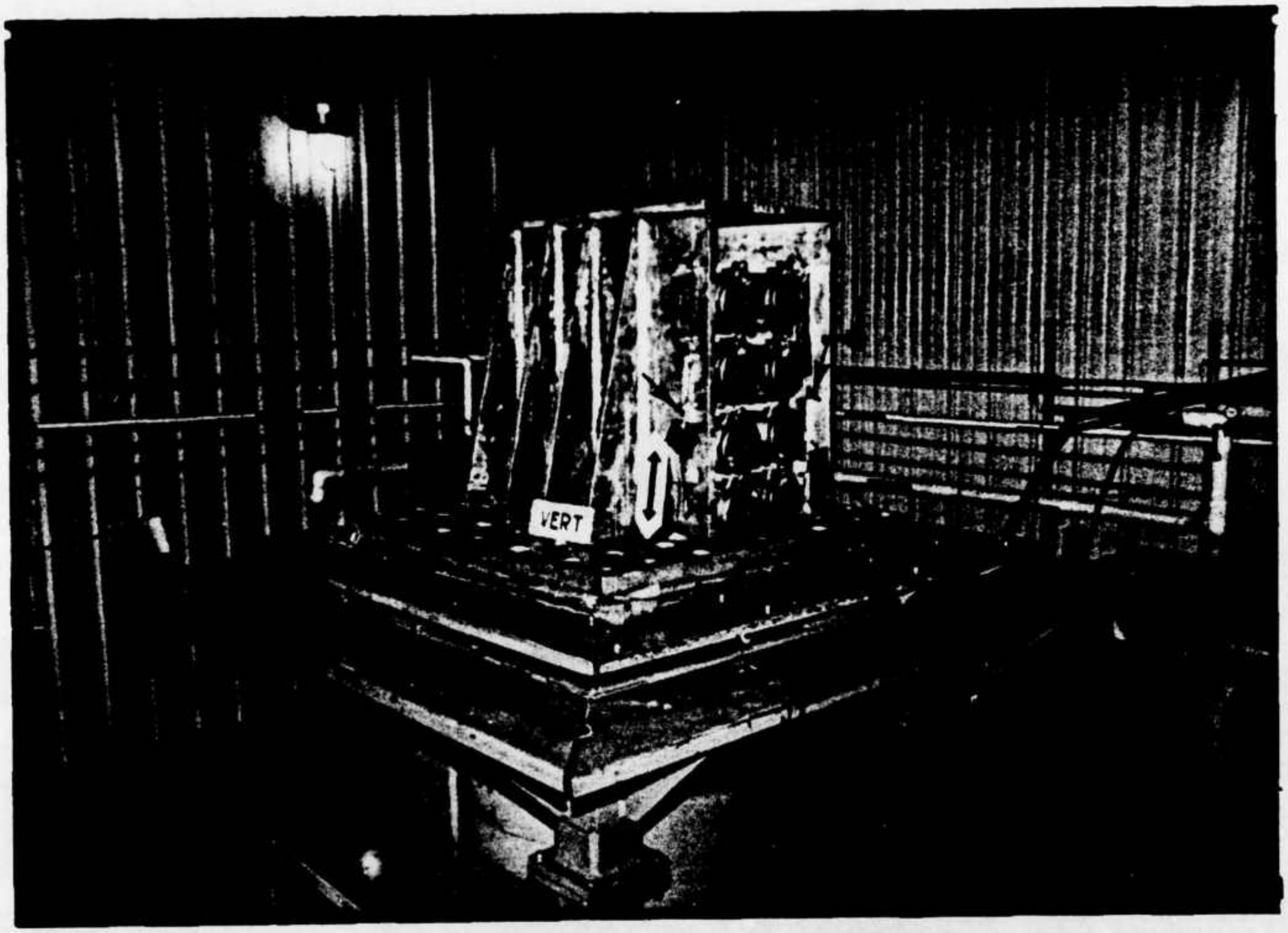


Figure B-1. General view of the vertical installed-equipment (rack) test setup. Arrow indicates visible control accelerometer location.

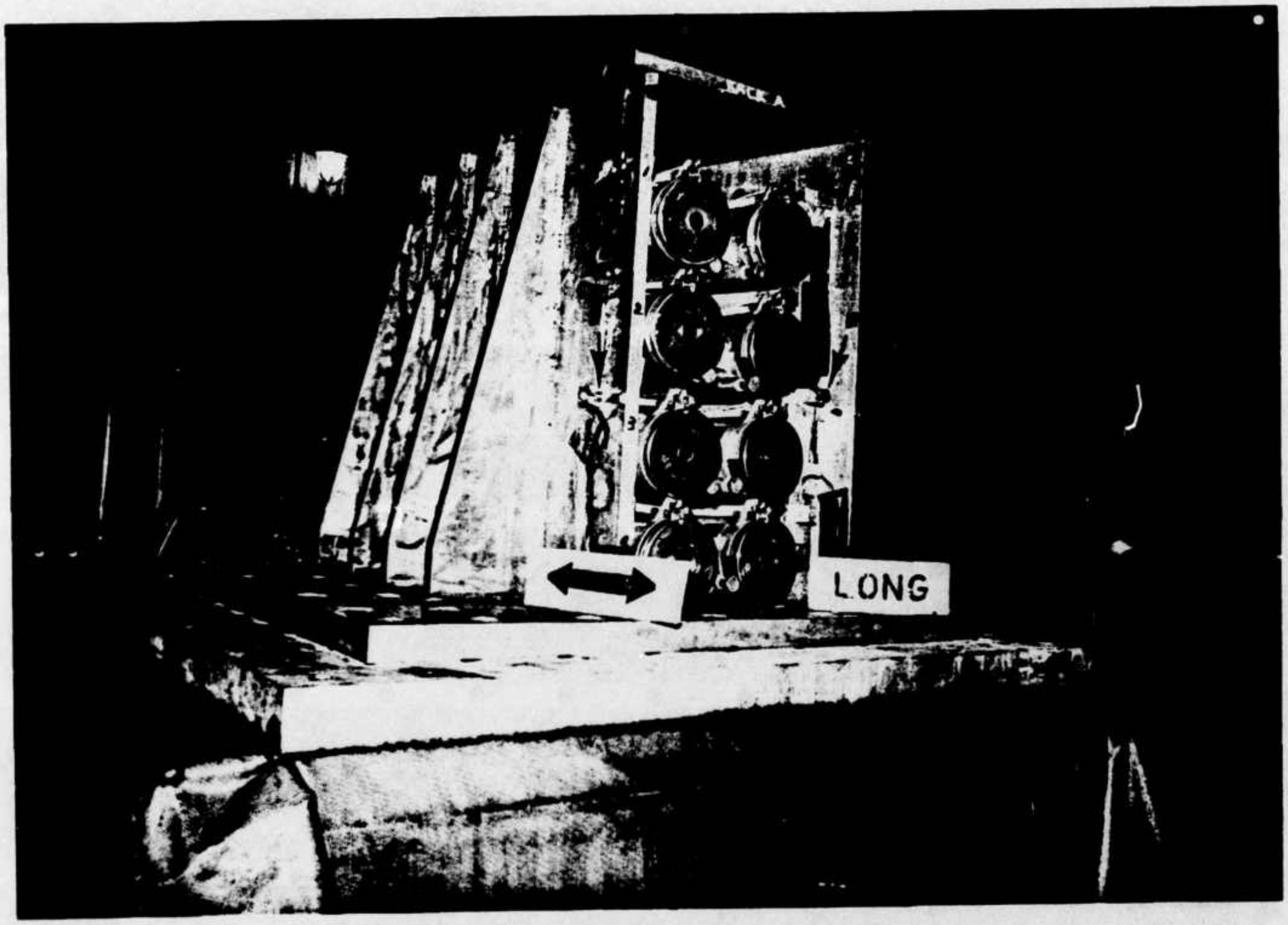


Figure B-2. General view of the longitudinal installed-equipment (rack) test setup. Arrows indicates visible control accelerometer location.

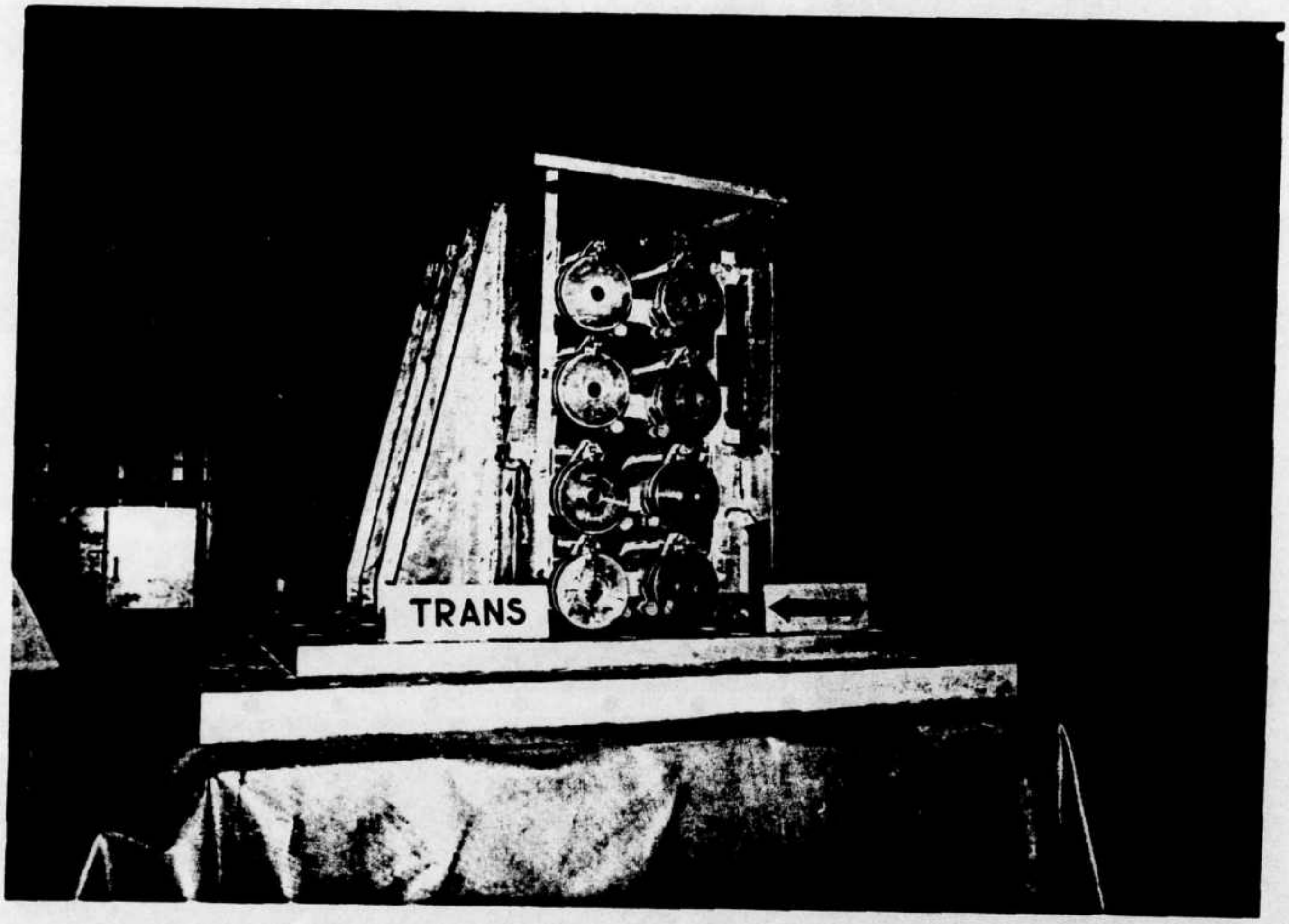


Figure B-3. General view of the transverse installed-equipment (rack) test setup. Arrows indicates visible control accelerometer location.

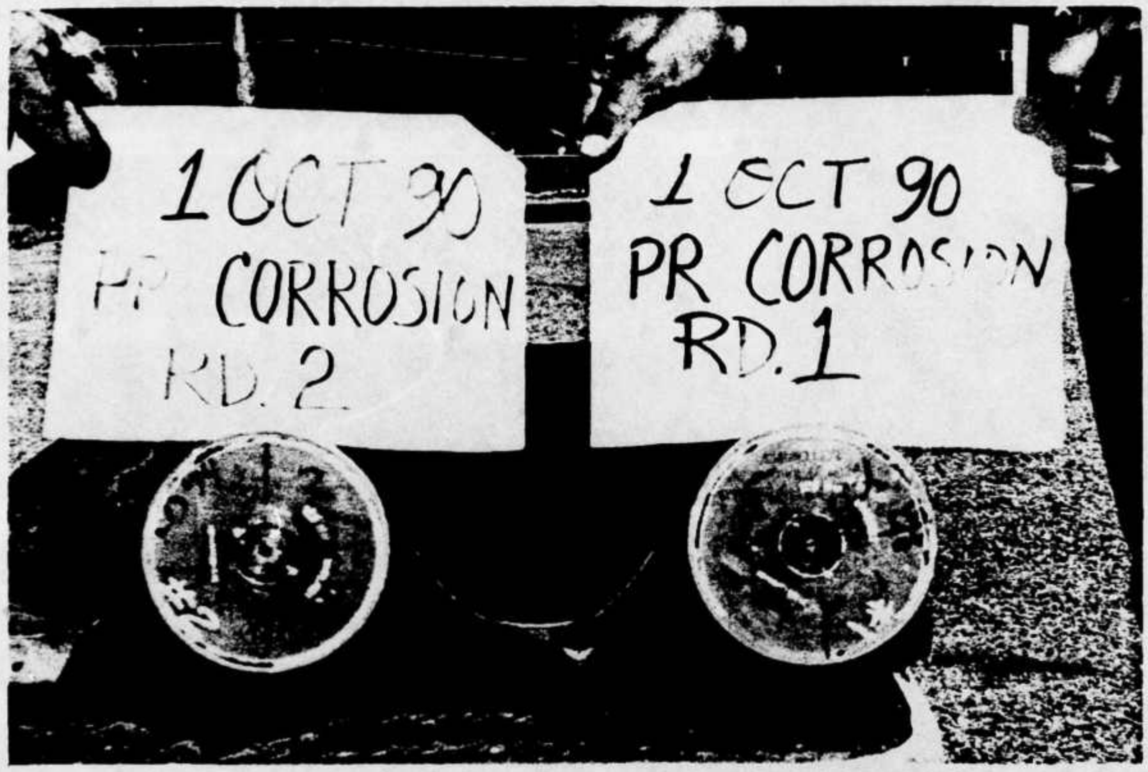


Figure B-4. M456A2 test cartridge No. 1 and 2 after environmental tests with no corrosion buildup.

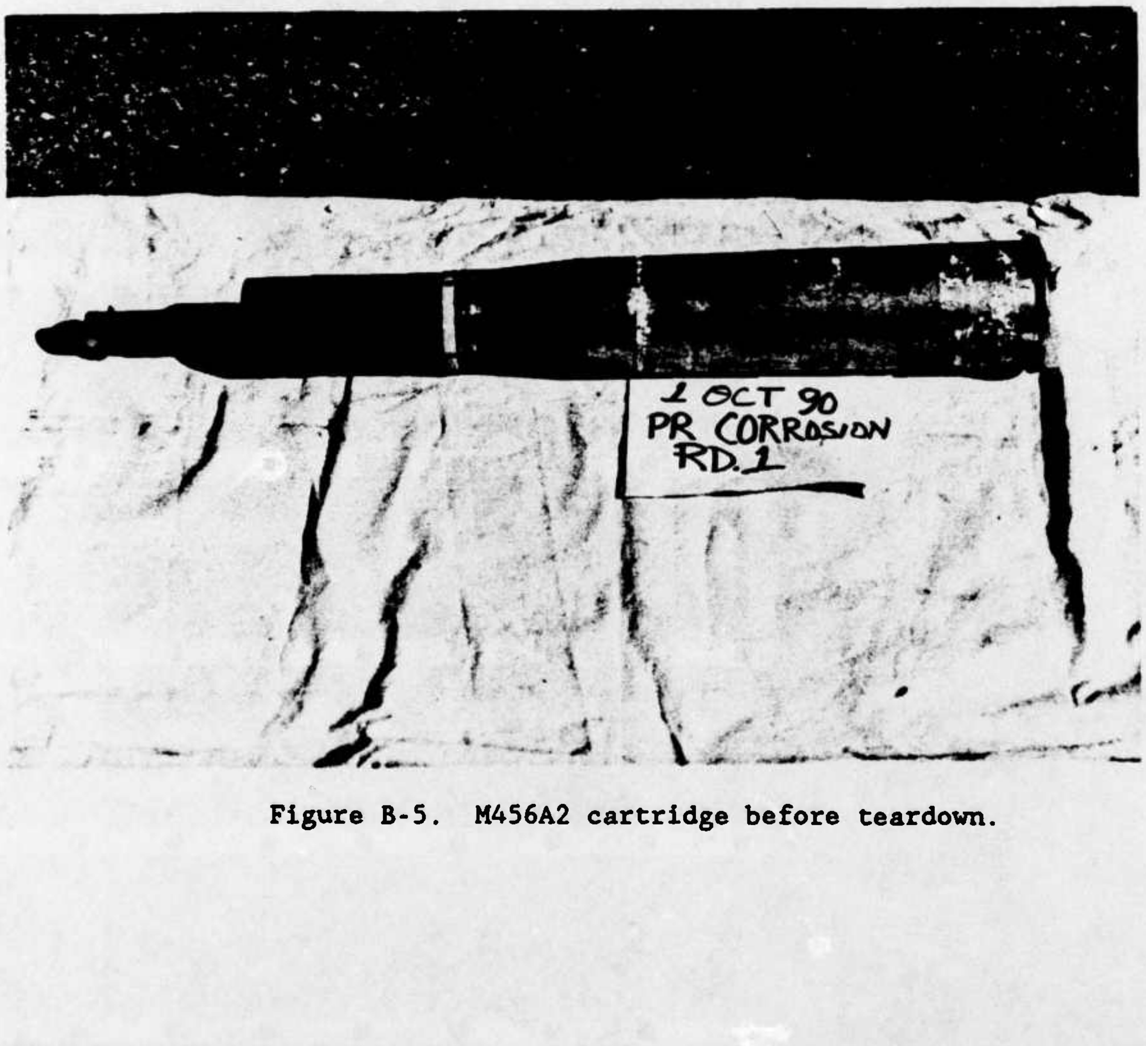


Figure B-5. M456A2 cartridge before teardown.

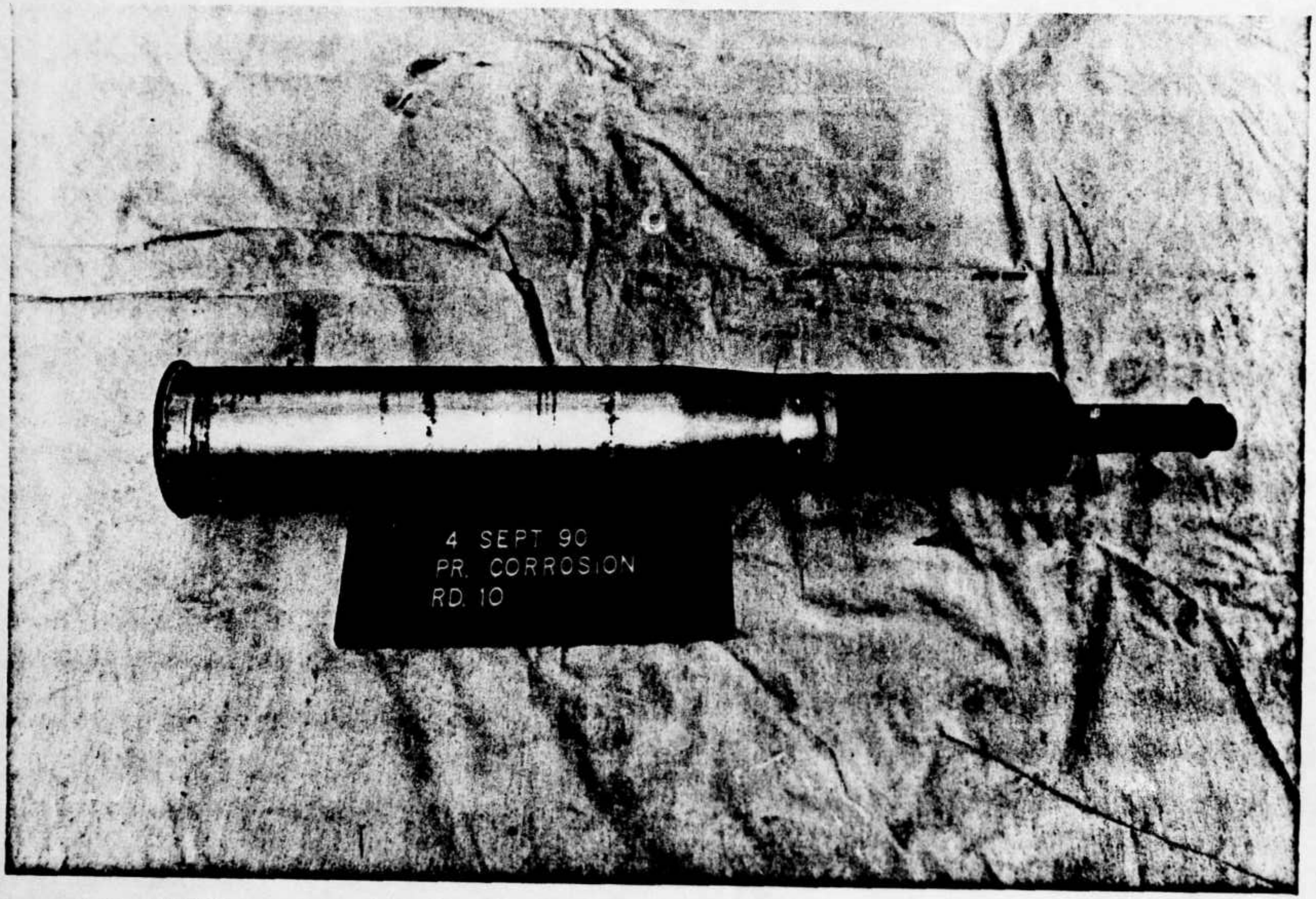


Figure B-6. M456A2 test cartridge No. 10 after all environmental tests were completed and showing corrosion buildup.

Figure B-7. Test cartridge No. 10 from the primer end of the case showing corrosion buildup around the primer.

Figure B-8. Test cartridge No. 10 showing corrosion on the internal lip of the case after disassembly.

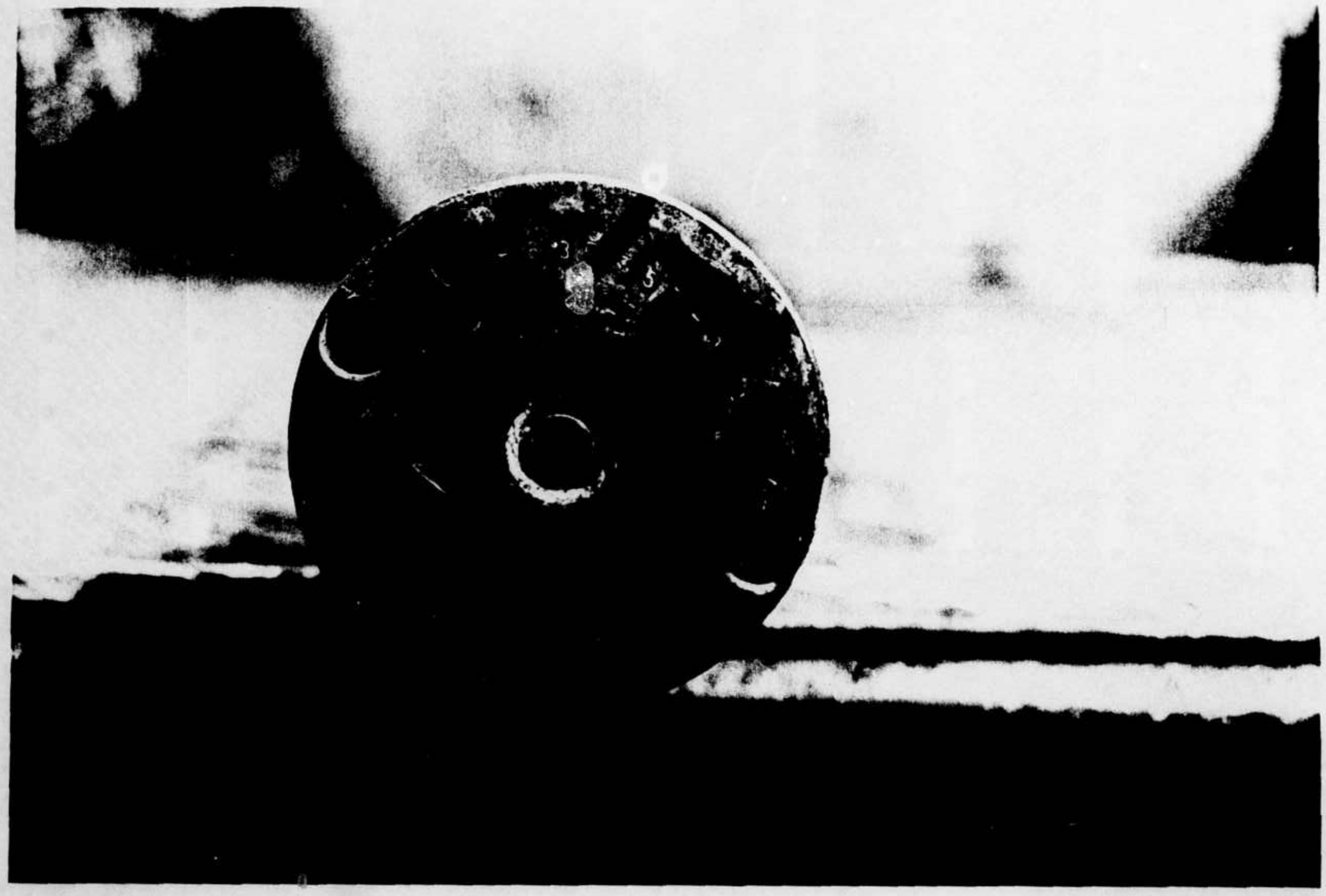


Figure B-9. Primer from test cartridge No. 10 after disassembly, and condition of the cartridge after teardown inspection.

APPENDIX E. DISTRIBUTION LIST

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APPENDIX C. REFERENCES

1. Memorandum, TECOM, AMSTE-TA-R, 20 November 1989, subject: Test Execution Directive, Cartridge, 105-MM, HEAT-T-MP, M456A2 (Corrosion Investigation), TPR DSN-AB-3496-1A, TECOM Project No. 1-MU-001-456-075.

2. MIL-STD-810D, Environmental Test Methods and Engineering Guidelines, 19 July 1983

3. MIL-STD-331A, Fuze and Fuze Components, Environmental and Performance Tests for, 15 October 1976; Notice 1, 19 May 1978; Notice 2, 21 January 1980; Notice 3, 4 January 1982; Notice 4, 12 February 1982; Notice 5, 18 May 1982.

4. Drawings for Cartridge, 105-MM: HEAT-T, M456A1 Tank Ammunition.

5. ITOP 1-2-601, Laboratory Vibration Schedules, 1 March 1988.

APPENDIX D. ABBREVIATIONS

HEAT-T-MP = high explosive, antitank, munition with tracer, multipurpose
ITOP = International Test Operations Procedures
MIL-STD = Military Standard
MP = multipurpose
NSN = national stock number
T = tracer
TPR = test program request

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